Decision-making Factors in Non-operative Management of Zygomatic Fractures

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ABSTRACT

Objective: A zygomatic fracture is one of the most common fractures of the maxillofacial bone. The treatment of zygomatic fractures can be performed either by surgical or non-surgical management. However, few studies have evaluated the reasons for choosing non-surgical treatment.

Methods: A retrospective observational study was performed of patients with zygomatic fractures that presented in Siriraj Hospital, Thailand, from January 1, 2010, to December 31, 2014. The factors associated with the non-operative treatment of zygomatic fractures were evaluated. Moreover, we analyzed the patient data, such as their age, etiology, type of fracture, complications, associated facial fractures, and associated other organ injuries.

Results: There were 337 patients with a zygomatic fracture during this period. Most of the cases involved males. Traffic accidents represented a common cause of the fracture. The mean patient age was 36 years old. Trimalar fracture of the zygoma was the most common type of fracture. The most common complication with zygoma fractures was infraorbital nerve injury. Of the study population, 161 patients (47.8%) received non-operative treatment and 176 patients (52.2%) received operative treatment. Older age (adjusted odds ratio (95% CI); 1.02 (1.00-1.03), p-value = 0.049), no diplopia (adjusted odds ratio (95% CI); 12.30 (3.28-46.14), p-value < 0.001), no infraorbital nerve injury (adjusted odds ratio (95% CI); 6.76 (3.81-11.99), p-value < 0.001), and no cosmetic concern (95% CI); 92.82 (11.97-719.44), p-value < 0.001) were the only four factors related to non-operative management decisions.

Conclusion: Older age, no diplopia, no infraorbital nerve injury, and no cosmetic concern of the patient were the factors associated with the non-operative treatment of zygomatic fractures.

Keywords: Zygomatic fracture; factors; non-operative treatment (Siriraj Med J 2019; 71: 450-456)

INTRODUCTION

A zygomatic fracture is a common fracture of the facial skeleton. The incidence and etiology of zygomatic fractures vary and differ among the reported studies. For example, one study reported that the main causes of zygomatic fractures were traffic accidents (26%), assault (20%), accidental falls (19%), sports injuries (10%), home injuries (8%), and work accidents (6%)[1], while another reported retrospective review found that the most common causes of zygomatic fractures were motor vehicle accidents (40%), followed by assault (22%), motorcycle accidents (12%), and all-terrain vehicle accidents (7%), respectively.[2]

The management of zygomatic fractures also vary, depending on the institution or trauma center. Previous research has reported that a high incidence of zygomatic fractures (66%) could be managed non-operatively without significant complications.[2] Another report studied the

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variables related to the surgical and non-surgical treatment of zygomatic complex fractures and found that the presence of other facial fractures, alteration of occlusion, presence of comminuted fractures, and infraorbital nerve sensory disturbances were statistically associated with the surgical treatment of zygomatic fracture.[3]

Nowadays, the non-operative treatment of a fracture of the facial skeleton is interesting, but there are few reports in the published literature on the conservative treatment of facial fractures.[4] A previous study reported that most patients with facial fractures in their study population were managed with non-operative treatment.[4] They set some criteria for the non-operative treatment of facial fractures and found that an undisplaced/minimally displaced fracture (57%) or minimal/no symptoms (24%) resulted in the patient undergoing conservative treatment.[4] However, data about the factors associated with the decision to apply a non-operative management of zygomatic fractures are lacking. Consequently, we conducted this research to identify the factors associated with the non-operative treatment of zygomatic fractures. Moreover, we evaluated the patients' age, etiology, type of fracture, complications, and time of hospital arrival in a level I trauma center in Thailand.

MATERIALS AND METHODS

A retrospective observational study was performed of patients with a zygomatic fracture who presented to the Facial Fracture Clinic, Division of Trauma Surgery, Siriraj Hospital, Mahidol University, Thailand, during a period of 5 years, from January 1, 2010, to December 31, 2014. This study was approved by the ethical committee for human research of Mahidol University (Si 641/2559). The inclusion criteria for this study were patients who were diagnosed with a zygomatic fracture (based on ICD-10) and who were treated at the Facial Fracture Clinic (FFC Clinic), Division of Trauma Surgery, Department of Surgery, Siriraj Hospital. The exclusion criteria were: (1) patients who refused treatment, (2) patients who died at arrival or during hospital admission, and (3) patients who had incomplete medical records.

In this study, we classified a zygomatic fracture into five types, based on Siriraj Hospital's classification of zygomatic fractures, namely: (1) classical sutural fracture of the zygoma (trimalar fracture), (2) comminuted fracture of the zygoma, (3) zygomaticomaxillary complex fracture, (4) isolated fracture of the zygomatic arch, and (5) isolated fracture of the frontal process of the zygoma. For data analysis, we used the Pearson chi-square test for discontinuous data analysis, and the Mann–Whitney U-test for continuous data analysis (not a normal distribution). Simple and multiple logistic regressions were used to investigate the factors associated with the non-operative treatment of zygomatic fractures. We used the software PASW Statistics 18.0 (SPSS Inc., Chicago, IL, USA) for the data analysis.

RESULTS

In total, there were 337 patients included in this study. The patients overall demographic data are shown in Table 1. The patients were split into two groups based on treatment, with 161 patients (47.8%) placed in the non-operative treatment group and 176 patients (52.2%) placed in the operative group. The majority of the patients were males, representing 261 patients (77.4%), while the females accounted for 76 patients (22.6%). The median patient age (overall) was 30 years old (Min–Max.: 11-92). In the non-operative treatment group, the median age was 41.0 years old (Min–Max.: 14-92), while in the operative treatment group, the median age was 30.5 years old (Min–Max.: 11-91). The most common age group that suffered from a zygomatic fracture was 21-40 years old (128 patients, 38.0%), while the least frequent age group to suffer such a fracture was those more than 80 years old (14 patients, 4.2%) (Fig 1).

The most common types of zygomatic fracture (based on Siriraj Hospital's classification of zygomatic fracture) were a trimalar fracture (272 patients, 80.7%), isolated zygomatic arch fracture (27 patients, 8.0%), zygomaticomaxillary complex fracture (25 patients, 7.4%), isolated frontal process fracture (9 patients, 2.7%), and the least common of fracture was comminuted zygomatic arch fracture (4 patients, 1.2%) (Table 1).

The most common etiologies of the zygomatic fractures were traffic accident (219 patients, 65%), assault (54 patients, 16%), sport injuries (4 patients, 1.2%), occupational accidents (3 patients, 0.9%), and other etiologies (57 patients, 16.9%) (Fig 2).

The most frequent times of hospital arrival were within 6 hours (54.6%), more than 24 hours (31.8%), 6 to 12 hours (5.0%), 18 to 24 hours (4.7%), and 12 to 18 hours (3.9%) (Fig 3).

Data were analyzed using multiple logistic regression to identify the factors associated with the non-operative treatment of zygomatic fracture and it was found that older age, no underlying disease (crude odds ratio (95% CI); 2.99 (1.64-5.14), p-value < 0.001), no other facial fracture disease (crude odds ratio (95% CI); 1.66 (1.08-2.56), p-value = 0.022), no diplopia (crude odds ratio (95% CI); 8.32 (2.45-28.19), p-value < 0.001), no infraorbital nerve injury (crude odds ratio (95% CI); 3.54 (2.18-5.74), p-value < 0.001), and a time of hospital arrival 6.01-

TABLE 1. Demographic data of the patients with zygomatic fracture.

Demographic data	Non-operative treatment (%)	Operative treatment (%)	Total (%)	*P*-value
Age (year)				
Median (Min.-Max.)	41.0 (14-92)	30.5 (11-91)	36 (11-92)	
1-20	26 (16.1)	44(25)	70 (20.8)	
21-40	53 (32.9)	75 (42.6)	128 (38.0)	< 0.001
41-60	45 (28.0)	46 (26.1)	91 (27.0)	
61-80	25 (15.5)	9 (5.1)	34 (10.1)	
>80	12 (7.5)	2 (1.1)	14 (4.2)	
Gender				
Male	131 (81.4)	130 (73.9)	261 (77.4)	0.100
Female	30 (18.6)	46 (26.1)	76 (22.6)	
Etiology				
Traffic accident	99 (61.5)	120 (68.2)	219 (65.0)	
Assault	22 (13.7)	32 (18.2)	54 (16.0)	
Sport	2 (1.2)	2 (1.1)	4 (1.2)	0.071
Occupational	1 (0.6)	2 (1.1)	3 (0.9)	
Others	37 (23.0)	20 (11.4)	57 (16.9)	
Type of fracture (Siriraj Classification)				
Classical sutural fracture of the zygoma (Trimalar fracture)	133 (82.6)	139 (78.9)	272 (80.7)	
Comminuted fracture of the zygoma	1 (0.6)	3 (1.7)	4 (1.2)	
Zygomaticomaxillary complex fracture	7 (4.3)	18 (10.3)	25 (7.4)	0.085
Isolated fracture of the zygomatic arch	17 (10.6)	10 (5.7)	27 (8.0)	
Isolated fracture of the frontal process of the zygoma	3 (1.9)	6 (3.4)	9 (2.7)	
Complications				
Infra-orbital nerve (ION) injury	33 (20.5)	84 (47.7)	117 (34.7)	<0.001
Diplopia	3 (1.9)	24 (13.6)	27 (8.0)	<0.001
Malocclusion	2 (1.2)	5 (2.8)	7 (2.1)	0.304
Cosmetic concern	1 (0.6)	37 (21.0)	38 (11.3)	<0.001
Time of hospital arrival				
≤6 hr.	101 (62.7)	83 (47.2)	184 (54.6)	
6.01-12 hr.	10 (6.2)	7 (4.0)	17 (5.0)	
12.01-18 hr.	5 (3.1)	8 (4.5)	13 (3.9)	0.014
18.01-24 hr.	8 (5.0)	8 (4.5)	16 (4.7)	
>24 hr.	37 (23.0)	70 (39.8)	107 (31.8)	
Associated facial fracture				
Nasal fracture	9 (5.6)	14 (8.0)	23 (6.8)	0.390
Maxillary fracture	22 (13.7)	29 (16.5)	51 (15.1)	0.472
Mandibular fracture	2 (1.2)	11 (6.3)	13 (3.9)	0.017
Orbital fracture	38 (23.6)	54 (30.7)	92 (27.3)	0.145
Other facial fracture	17 (10.6)	21 (11.9)	38 (11.3)	0.691
Associated other organ injury				
Head injury	61 (37.9)	53 (30.1)	114 (33.8)	0.132
Orthopedics fracture	23 (14.3)	21 (11.9)	44 (13.1)	0.522
Chest injury	10 (6.2)	1 (0.6)	11 (3.3)	0.004
Abdominal injury	5 (3.1)	4 (2.3)	9 (2.7)	0.636
Eye injury	67 (41.6)	82 (46.9)	149 (44.3)	0.334
Soft tissue injury	41 (25.5)	45 (25.7)	86 (25.6)	0.958
Other injury	34 (21.1)	35 (19.9)	69 (20.5)	0.780
None injury	24 (14.9)	31 (17.6)	55 (16.3)	0.502

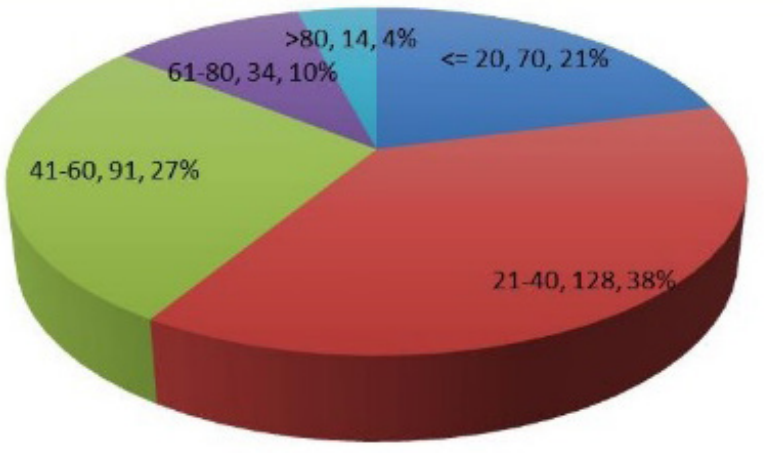

Fig 1. Patients' demographic data. The demographic data of zygomatic fracture were demonstrated. The numbers in the histogram represent age incidence (years), the number of cases, the percentage of cases from total 337 cases, respectively.

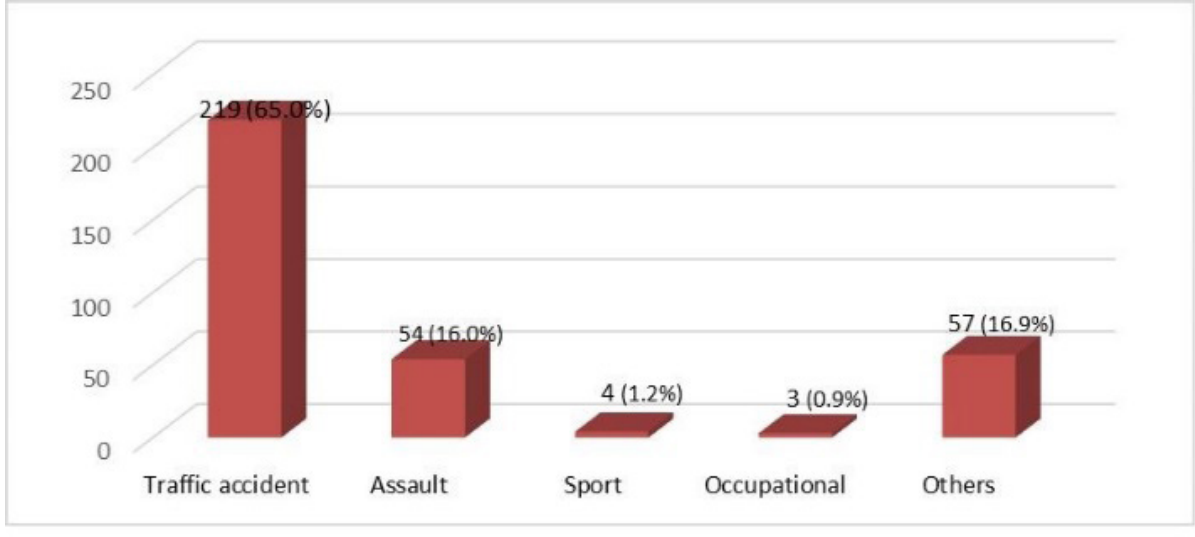

Fig 2. Etiology of injury. The etiology of zygomatic fracture was categorized in x axis, while the number of cases and the percentage of cases from total 337 cases was demonstrated in each etiology.

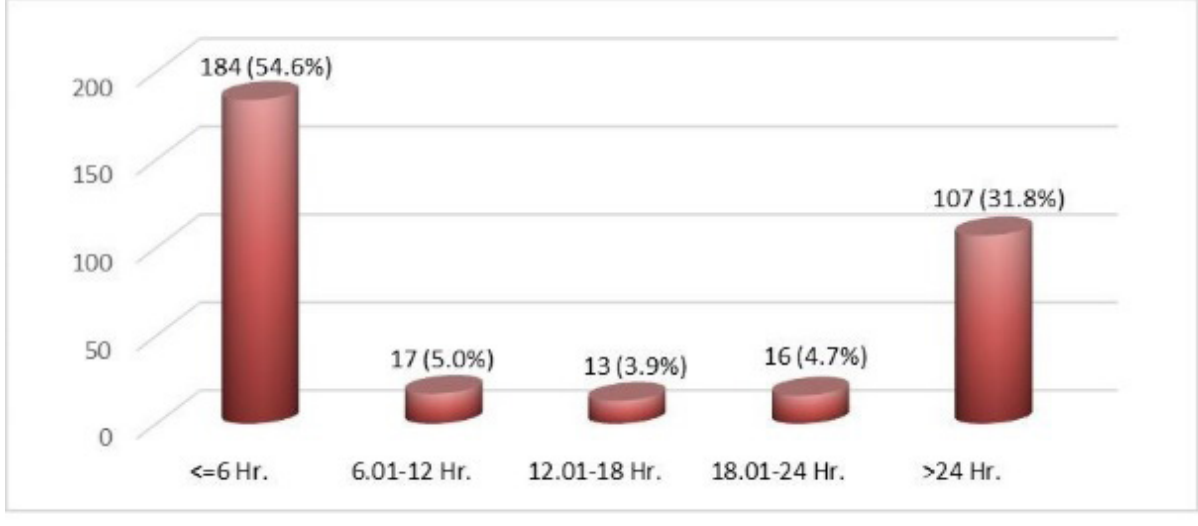

Fig 3. Time of hospital arrival. The duration from time of injury to hospital visit of each patient with zygomatic fracture was recorded, and categorized in x axis. The histogram demonstrated the time interval and the number and the percentage of cases in each interval.

12 hours (crude odds ratio (95% CI); 2.30 (1.41-3.77), *p*-value < 0.001) were the factors associated with the non-operative treatment of a zygomatic fracture when the analysis was performed using univariable analysis, but when we used multivariable analysis, we found that older age (adjusted odds ratio (95% CI); 1.02 (1.00-1.03), *p*-value = 0.049), no diplopia (adjusted odds ratio (95% CI); 12.30 (3.28-46.14), *p*-value < 0.001), no infra-orbital nerve injury (adjusted odds ratio (95% CI); 6.76 (3.81-11.99), *p*-value < 0.001), and no cosmetic concern (95% CI); 92.82 (11.97-719.44), *p*-value < 0.001) were the only factors associated with the non-operative treatment of zygomatic fracture (Table 2).

DISCUSSION

Due to the differences in the nature of each injury in trauma patients, the analysis of management modalities is difficult.[4,5] Non-operative treatment may be used in any individual patient, but there are no definite criteria for deciding on such treatment in the management of zygomatic fracture.[3,4] Consequently, realizing which factors are associated with the non-operative treatment of zygomatic fracture should help the decision-making for the treatment modalities.[3]

In our study, most of the zygomatic fracture cases, which were most common in males, were caused by traffic accidents. The mean patient age was 36.0 years old. These represent similar results, albeit with a little difference in percentages, when compared with another study that reported that zygomatic complex fractures were more common in men (80.1%) than women (19.9%), and the average patient age was 35.3 years old.[3] High energy and moderate energy mechanisms are associated with more comminution and displacement of the fractures, and this may need more operative intervention.[6] Despite the difference in ratios of the etiologies of the injury between a previous study, which reported that the most common causes of the injuries were due to personal aggression (19.5%), followed by falls (18.8%)[3], and our data, which found that most the injuries due to traffic accidents (65%), the data from both studies showed similar results in that there was no statistically significant association between the etiology and the decision made between the surgical treatment or non-operative treatment of zygomatic fracture.[3]

In this study, the most common type of zygomatic fracture was trimalar fracture and the most common complication of the fracture was infraorbital nerve injury,

TABLE 2. Factors associated with non-operative treatment of zygomatic fracture

Factors	Crude odd ratio (95% CI)	*P*-value	Adjusted odd ratio (95% CI)	*P*-value
Age			1.02(1.00-1.03)	0.049
None underlying disease	2.99(1.64-5.14)	< 0.001	1.80(0.79-4.14)	0.165
Non other facial fracture	1.66 (1.08-2.56)	0.022	1.46(0.83-2.54)	0.187
No diplopia	8.32(2.45-28.18)	0.001	12.30(3.28-46.14)	<0.001
No infra-orbital nerve injury	3.54(2.18-5.74)	<0.001	6.76(3.81-11.99)	<0.001
No cosmetic concern	42.59(5.77-314.46)	<0.001	92.82 (11.97-719.44)	<0.001
Time of hospital arrival				
<=6 Hr.	0.53	0.002		0.440
6.01-12 Hr.	2.30(1.41-3.77)	0.001	1.07(0.32-3.58)	0.911
12.01-18 Hr.	2.70(0.95-7.68)	0.062	0.53(0.12-2.31)	0.401
18.01-24 Hr.	1.18(0.36-3.87)	0.782	0.98(0.26-3.65)	0.979
>24 Hr.	1.89(0.66-5.45)	0.237	0.57(0.31-1.06)	0.077

respectively. Diplopia usually relates to an orbital wall defect and intraorbital fat compromise and/or extraocular muscles entrapment[7] and these patients need more extensive evaluation and observation.[8] In our research, 27 patients (8.0 %) presented this sign and we found that the lack of diplopia was statistically associated with the non-operative treatment of zygomatic fractures (p-value < 0.001). This was in contrast to the previous study, which reported that only 8 cases out of 43 patients with diplopia were in the operative treatment group, and they concluded that there was no statistically significant association between diplopia and the operative treatment of zygomatic fractures.[3] However, another study showed that 7% of cases presented with diplopia, and all were in the surgical group.[9] Thus, we concluded that the lack of diplopia (no diplopia) was one of factors associated with the non-operative treatment of zygomatic fracture.

The incidence of infraorbital nerve sensory disturbances in zygomaticomaxillary complex (ZMC) fractures has been reported to vary from 24% to 94%[10,11], and it has been found that infraorbital nerve sensory disturbances were the most common sequelae after ZMC fracture.[12] Previous studies reported that only 5.8–18% of cases did not present infraorbital nerve sensory disturbances, and most surgical patients showed this sign.[9,13] These previous studies concluded that patients with ZMC fracture presenting infra-orbital nerve sensory disturbances were highly correlated with operative treatment.[9,13] In this study, we demonstrated that the presence of infraorbital nerve injury was associated with operative treatment in zygomatic fracture, and the lack of infraorbital nerve injury was statistically significantly associated with the non-operative treatment of zygomatic fracture.

The presence of comorbidity may be correlated with adverse peri-operative events and may increase the risk of morbidity and mortality in surgical patients,[14] and here, the ASA classifications are the key predictors of major complications in head and neck surgery.[15] In our study, we found that the absence of comorbidity was correlated with the non-operative treatment of zygomatic fracture when we analyzed the data using univariable analysis, but it was not statistically associated with non-operative treatment when analyzed using multivariable analysis.

A previous study showed that the cosmetic or aesthetic outcome was the dominant indicator for the treatment of zygomatic fracture, and concluded that the aesthetic result is predominantly the principal indication of surgical fixation in most zygomatic fractures.[16] Similarly, our results demonstrated that having no cosmetic concern was strongly statistically significantly associated with the non-operative treatment of zygomatic fracture. Many studies have found that more complex facial fractures, such as naso-orbito-ethmoidal fractures, maxillary fractures, or mandibular fractures, are associated with a high energy trauma mechanism.[3,6] Our data showed some correlation, but not statistically significant, between other facial fractures and the non-operative treatment of zygomatic fracture. Besides, other factors, such as time of hospital arrival and the presence of associated other organ injury, did not show any correlation with operative management modalities. Thus, it may be assumed that the etiology, time of hospital arrival, and the severity of injury as well as the presence of other injuries and any comorbidity did not affect directly the decision-making in the management of zygomatic fractures. On the other hand, some studies, which used radiographic findings of the facial anatomy in their classification, showed a relationship between the etiology, or the severity of injury, or other facial fractures, and the surgical management of zygomatic complex fractures.[3,6,7] The differences in these relationships may be due to the different classifications of facial fractures. For example, when patients had a radiographic diagnosis of a bilateral zygomatic complex fracture and if presenting to our institute with fractures around the midline components of the facial skeleton, e.g. naso-orbital-ethmoid fractures, then the diagnosis of Lefort fractures were given in these cases, and they were not enrolled in this study. In summary, we could summarize that patients who presented with zygomatic fracture and had the following important factors, e.g., older age, no diplopia, no infraorbital nerve injury, and no cosmetic concern, could be treated with non-operative treatment, and in the future we may be set up definite criteria for the non-operative treatment of zygomatic fracture to ensure the best treatment for the patient population.

There were some limitations in this study to report: (1) this study was a retrospective study and we did not mention results concerning complications and the duration of any complication that the patient suffered because of incomplete or a lack of data about this in this study, (2) there were many surgeons in this study who treated the patients and applied no standard guideline treatment, leading to confounding factors and selection bias that depended on the individualized treatment of the surgeons. Further research is advised, especially regarding the non-operative treatment of zygomatic fracture for creating standard treatment guidelines and for setting up criteria for this treatment group in the future.

CONCLUSION

In our study, we found that the majority of the patients were male, the most common type of zygomatic fracture was a trimalar fracture, the most common etiologies of zygomatic fracture were traffic accidents and assault, respectively, and the most frequent time of hospital arrival was within 6 hours. Older age, no diplopia, no infraorbital nerve injury, and no cosmetic concern were the factors associated with the non-operative treatment of zygomatic fracture.

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