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ASSOCIATION BETWEEN ORO-FACIAL SOFT TISSUE INJURIES AND ORAL AND MAXILLOFACIAL FRACTURES

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ABSTRACT

Introduction: Almost all hard tissue injuries in oral and maxillofacial region are associated with some type of soft tissue injuries; however, the relationship between different types of oro-facial soft tissue injuries and various maxillofacial bone fractures is not well-established.

Objectives: To assess the association between soft tissue injuries and underlying hard tissue injuries in the oral and maxillofacial region.

Material and methods: This was a prospective study among patients with oral and maxillofacial soft tissue injuries treated at Muhimbili National Hospital. Variables examined included age, sex, etiology of injury, location of soft tissue injury, and type of maxillofacial fracture sustained. Data were analyzed using IBM SPSS software version 23. Logistic regression was applied to analyze the relationship between the type of soft tissue injuries and the associated underlying hard tissue injuries.

Results: The study included 160 patients, who had sustained soft tissue injuries to the oro-facial region. Non-ending sub-conjunctival ecchymosis was the soft tissue injury that was strongly associated with zygomatico-maxillary fractures (OR: 5.8; 95% CI: 1.85-18.16), and hematoma of the floor of the mouth was positively associated with para-symphyseal fractures of the mandible (OR: 4.7; 95% CI: 1.16-19.42). Laceration to the forehead is most suggestive of an underlying fracture of the frontal bone, while contusion/laceration on the palate predicts Le-Fort I or II fractures.

Conclusions: The findings of this study concluded that certain types of oro-facial soft tissue injuries can aid in the diagnosis of specific underlying maxillofacial bone fractures.

Key words: maxillofacial fractures, laceration, hematoma, Le-Fort fractures.

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INTRODUCTION

In massive facial trauma patients, clinical evaluation of hard tissues is often difficult because of excessive oedema or bleeding, and the use of conventional radiographs of the head may be limited due to overlapping nature of images of bones. Therefore, in these circumstances, computerized tomography scanning provides a better diagnostic advantage [1].

In recent years, there has been a rise in oro-facial injuries in most developing countries, including Tanzania, partly because of an increase of road traffic crashes, especially motorcycle-related [2]. Yet still, the availability of CT scans is very limited, and when available, most of the patients cannot afford the cost, which delays diagnosis and appropriate management.

However, considering that anatomically, the basic form of the oro-facial region is determined by the hard

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tissues, which envelop the soft tissues (skin, subcutaneous tissues, fat, muscles, glands, and their ducts and mucosa) [3], almost all hard tissue injuries to the oral and maxillofacial region are associated with some type of soft tissue injuries [4, 5]. Therefore, it is essential to anticipate injuries to any of the various structures underneath an apparent wound [4]. Fabio *et al.* [6] found an association between facial lacerations and underlying maxillofacial bones fracture. However, there is a paucity of information regarding the association between other types of oro-facial soft tissue injuries, such as abrasions, contusions, lacerations, hematoma, and avulsions, which may occur as a single-type or a combination of different types [4, 5, 7-11], with underlying maxillofacial fractures.

OBJECTIVES

This study aimed at assessing the association between various types of oro-facial soft tissue injuries and underlying oral and maxillofacial hard tissue injuries. In this study, it was hypothesized that there is no association between the occurrence of different types of oro-facial soft tissue injuries and the presence of various maxillofacial bone fractures.

MATERIAL AND METHODS

This was a hospital-based study among consecutive patients with maxillofacial injuries, treated at the Department of Oral and Maxillofacial of the Muhimbili National Hospital (MNH), Dar-es-Salaam, Tanzania between November 2017 and February 2018. Inclusion criterion was patients with oral and maxillofacial soft tissue injuries. These injuries included laceration, hematoma, contusion, avulsions, degloving, and abrasion. Ethical clearance for this study was sought from ethical committee of the Muhimbili University of Health and Allied Sciences (Ref. No.: MU/ PGS/ SAEC/ Vol.X), while permission to conduct the study was obtained from the administration of MNH.

All participants who consented to participate in the study were interviewed using a specially designed questionnaire to obtain socio-demographic data, causes of injury, and associated symptoms. This was followed by a thorough clinical examination to determine the type of soft tissue injuries and their location, bone involvement, and status of the dentition. Radiological investigations were carried out to confirm the presence of fracture in the oral and maxillofacial region. In majority of cases, computed tomography scans (axial, coronal, and sagittal views supplemented with 3D views) were utilized (Figure 1). In a few cases of isolated mandibular fractures, orthopantomogram (OPG) was used (Figure 2).

Primary predictor variables were different types of soft tissue injuries, such as laceration, abrasion, avulsion, etc., and their location. Primary outcome variables were different types of hard tissue injuries in the oro-facial region and their location. Other variables included socio-demographic characteristics of patients and cause of injuries.

Data were de-identified and recorded in a standardized collection form, and analyzed using IBM SPSS Statistical software for Windows (version 23; IBM, Armonk, NY). Continuous data (age) was reported in terms of mean and for categorical data, frequency distribution together with cross-tabulation was performed. For analysis purposes, each type of soft tissue injury and its' location (laceration, abrasion, avulsion, etc.) was cross-tabulated with different types of maxillofacial bone fractures (as confirmed radiologically). Chi-square test was performed to establish an association between different types of soft tissue injuries and different types of maxillofacial

FIGURE 1. 3D reconstruction of skull CT scan revealing multiple facial bone fractures (both the midface and the mandible)

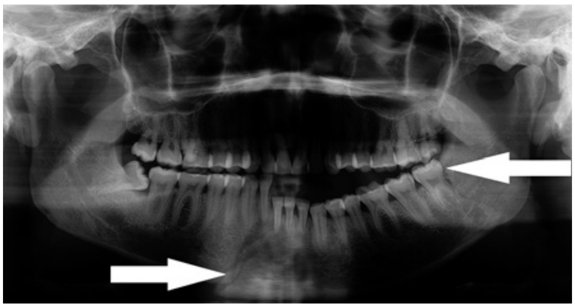

FIGURE 2. Orthopantomogram showing fracture of the mandible on the right parasymphyseal region and the left angle of the mandible

hard tissue injuries. *P*-value of < 0.05 was established. All oro-facial soft tissue injuries domain-specific predictors of maxillofacial fractures (based on radiological findings) with a *p*-value less than 0.1 were retained for final multiple regression models to analyze the relationship between the type of soft tissue injuries and underlying hard tissue injuries. Results were reported as odds ratio and 95% confidence interval.

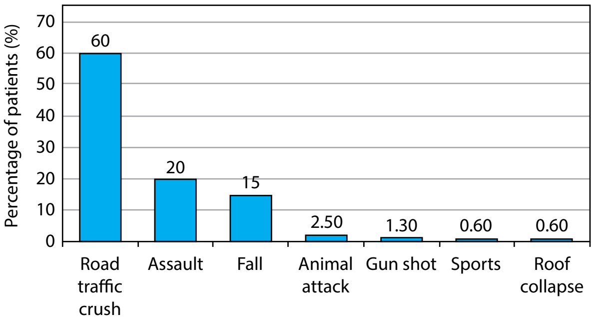

FIGURE 3. Distribution of patients with oral and maxillofacial injuries according to etiologies of injury

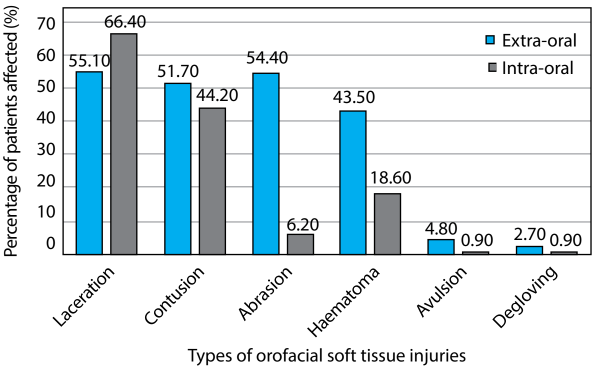

FIGURE 4. Distribution of patients with oral and maxillofacial injuries according to types of oro-facial soft tissue injuries

FIGURE 5. An arrow pointing at non-ending sub-conjunctival ecchymosis of the right eye

RESULTS

The study included a total of 160 patients, who suffered from soft tissue injuries in the oral and maxillofacial region. The age of the patients ranged from 1 month to 70 years, with a mean age of 28.23 ± 14.3 years. The majority of the patients were males (n = 129, 80.6%), with a male to female ratio of 4.2 : 1. The most frequent cause of oral and maxillofacial injuries among the patients was road traffic crash, followed by violence (Figure 3).

Oro-facial soft tissue injuries to the extra-oral sites were evident in almost all the patients (n = 147, 91.9%). The most common (55.1%) type of oro-facial soft tissue injuries in the extra-oral sites in 81 of patients was laceration, followed by abrasion in 80 (54.4%) patients and contusion in 76 (51.7%) patients. Whereas, intra-orally 110 (68.8%) patients suffered from oro-facial soft tissue injuries with laceration being the most frequent type in 75 (66.4%) patients, followed contusion in 50 (44.2%) and hematoma in 21 (18.6%) patients (Figure 4).

On physical examination, of the 160 patients with oro-facial soft tissue injuries, 101 (63.1%) patients were clinically diagnosed with maxillofacial fractures; however, upon radiological evaluation, the total number of patients with fractures was 112 (70%). Mandibular fractures occurred in 65 (58%) patients, while fractures to the midface and/ or frontal bone were observed in 76 (67.9%) patients.

All maxillofacial oro-facial soft tissue injuries domain-specific predictors of mandibular fractures (based on radiological findings) with a *p*-value less than 0.1 were retained for final multiple regression model. This model was adjusted for extra-oral hematoma of the cheeks, laceration of the chin, mandibular gingival laceration, and hematoma of the floor of the mouth. On performing multivariate analysis of the variables, only hematoma of the cheeks and floor of the mouth was positively associated with the occurrence of mandibular fractures. Hematoma of the cheeks was associated with 6-folds higher odds of fractures of the angle of the mandible (OR: 5.9; 95% CI: 1.19-29.48), and the odds of having mandibular para-symphyseal fracture in presence of hematoma in the floor of the mouth was 5 times higher (OR: 4.7; 95% CI: 1.16-19.42).

For the midface fractures, analysis was carried out for those fractures with a frequency of occurrence that was higher than 15, and included zygomatico-maxillary complex fracture (n = 42), Le-Fort I (n = 30), and Le-Fort II (n = 19) fractures. There was a 5-folds higher odds of diagnosing ZMC fracture in patients with non-ending sub-conjunctival ecchymosis (Figure 5). The odds of diagnosing Le-Fort I fracture was 24 times more in the presence of contusion of the posterior aspect of the hard palate (Figure 6). Soft palate contusion was associated with 13-folds higher odds of Le-Fort II fracture. The odds of having an underlying frontal bone fracture in the presence of a laceration to the forehead were 11-folds higher (Table 1).

DISCUSSION

In line with the global picture [5, 9, 12-14], in this study, males were predominantly affected by maxillofacial injuries. The male predominance has been attributed to gender-based activities, as males are more involved in risky adventures, such as riding motorcycles, driving vehicles, fighting, and jobs involving climbing [15-17].

The majority of the patients with oral and maxillofacial injuries in this study were young adults (mean age of 28.23 ± 14.3 years), which is in concurrence to findings from elsewhere [18-21]. The third and fourth decades of life are considered to be the most active periods, in which people tend to remain outdoors in search of their livelihood, thus becoming more vulnerable to injuries [3].

The diagnosis of a fracture is based on clinical history, signs and symptoms, visual findings, manual examination, and correct interpretation of radiographs [22]. Following the diagnosis, the goal of facial fractures treatment is to restore both the function and original facial contours [23]. However, in facial trauma patients, the diagnosis

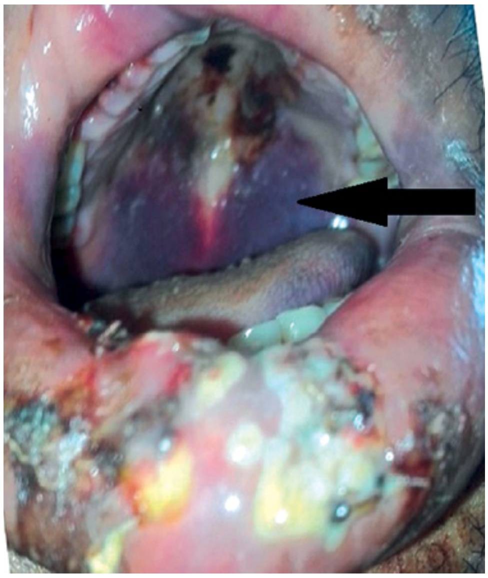

FIGURE 6. An arrow pointing at the contusion of the posterior aspect of the hard palate

TABLE 1. Multivariate logistic regression analysis of soft tissue injuries that were predictors of ZMC, Le-Fort I, Le-Fort II, and frontal bone fractures

Variables of interest	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Type of fracture: Zygomatico-maxillary complex fracture		
Non-ending sub-conjunctival ecchymosis	7.5 (2.69-21.00)	5.8 (1.85-18.16)
Periorbital contusion	2.8 (1.10-7.05)	1.4 (0.45-4.15)
Zygomatic region abrasion	2.8 (1.00-7.90)	1.7 (0.55-5.47)
Zygomatic region laceration	2.3 (0.42-12.63)	–
Orbital region laceration	1.8 (0.58-5.41)	–
Contusion of buccal vestibule	6.0 (1.24-29.38)	4.8 (0.87-25.96)
Type of fracture: Le-Fort I fracture		
Contusion of buccal vestibule	3.1 (0.91-10.69)	1.8 (0.37-9.20)
Contusion of posterior hard palate	23.0 (6.91-76.60)	24.0 (2.45-239.87)
Contusion of soft palate	12.1 (3.90-37.53)	0.9 (0.08-8.87)
Type of fracture: Le-Fort II fracture		
Sub-conjunctival ecchymosis	4.8 (1.27-18.30)	2.9 (0.51-16.70)
Periorbital contusion	5.5 (1.45-20.96)	5.2 (0.96-27.81)
Orbital region laceration	3.5 (0.66-18.48)	3.5 (0.66-18.48)
Contusion of buccal vestibule	2.28 (0.64-8.06)	–
Contusion of posterior hard palate	18.9 (4.76-74.88)	2.01 (0.2-20.36)
Contusion of soft palate	18.3 (5.03-67.14)	13.4 (1.25-144.26)
Type of fracture: Frontal bone fracture		
Laceration to forehead	9.2 (2.0-41.92)	11.2 (1.84-68.11)
Hematoma of forehead	6.1 (0.87-42.92)	–

of facial bone fractures may be difficult since clinical evaluation is impaired in the presence of either oedema or bleeding. Moreover, conventional radiographs of the head may be of limited use due to the overlapping nature of bones [1]. Even though, computerized tomography scanning is better for detecting maxillofacial fractures [1, 24], in most developing countries, such as Tanzania, the availability of these advanced imaging techniques is limited. This aspect along with the shortage of expertise in oral and maxillofacial injuries, may delay the diagnosis of oral and maxillofacial fractures, thus complicating their management subsequently.

Since almost all hard tissue injuries to the oral and maxillofacial region are associated with soft tissue injuries [4, 5], such soft tissue injury may be of much help in predicting and diagnosing the underlying fractures. In this study, a positive association between types of soft tissue injuries and underlying bone fractures was found, concurring with findings by Leite *et al.* [25].

In the current study, it was observed that while hematoma of the cheek was associated with fracture of the angle of the mandible, the presence of hematoma in the floor of the mouth was associated with parasymphyseal fracture. It is anticipated that upon fracturing the mandible, bleeding occurs as a result of injury to the inferior alveolar neuro-vascular bundle, followed by seepage of blood into the soft tissues. Depending on the direction of force and anatomical location of the fracture, the collection of blood in subcutaneous tissue becomes a hematoma that may be more pronounced on the lateral or medial aspect of the mandible.

Furthermore, this study revealed that there was 5-folds higher odds of diagnosing ZMC fracture in patients with non-ending sub-conjunctival ecchymosis. Sub-conjunctival ecchymosis is a frequent finding in zygomatic fractures, which is usually non-ending, caused by tearing of the periosteum due to fracture of the lateral orbital rim [26].

While in the presence of contusion/bruising of the posterior aspect of the hard palate, the odds of diagnosing Le-Fort I fracture were about 20 times higher, and a soft palate contusion was associated with 13-folds higher odds of diagnosing Le-Fort II fracture. These findings could be attributed to the fact that in Le-Fort fractures, there is usually involvement of the pterygoid process of the sphenoid bone, which leads to ecchymosis/contusion around the region of greater palatine foramen._

It has been documented that contusion in the area of the mucosa of the maxillary vestibule may be a sign of Le-Fort I fracture, and binocular hematoma is typical for Le-Fort II fracture [27]. In this study, the association between contusion of maxillary buccal mucosa and the occurrence of Le-Fort I fracture was insignificant. However, a positive association between periorbital contusion (raccoon eyes) and Le-Fort II fracture was noted, but on performing multivariate analysis, the association was found to be insignificant.

The major limitation of this study was that it was carried out in a tertiary hospital, and some patients who suffered from soft tissue injuries did not attend our center and were not assessed. Yet still, the results of this study might be helpful to the clinicians, especially in settings with limited resources, to have high suspicion index of diagnosing an underlying maxillofacial bone fracture in the presence of oro-facial soft tissue injuries. Therefore, the diagnosis of oro-facial fractures can be established despite missing radiological aid. Moreover, this study served as a reminder to the clinicians, especially those working in emergency medicine, to conduct a thorough examination of the oro-facial soft tissues in patients with oro-facial injuries.

CONCLUSIONS

The results of the preset study show that certain types of oro-facial soft tissue injuries are associated with a specific type of underlying maxillofacial bone fractures. Ecchymosis/contusion of the posterior aspect of the palate is highly suggestive of Le-Fort fractures. Laceration to the frontal region should raise high suspicion of frontal bone fracture. Hematoma of the cheek predicts fracture of the mandibular angle.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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