ORIGINAL ARTICLE

# MAXILLOFACIAL TRAUMA ASSOCIATED WITH OTHER BODY INJURIES: THE ROLE OF REVISED TRAUMA SCORING SYSTEM

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## ABSTRACT

**Objectives:** The purpose of this study was to evaluate the magnitude of other associated bodily injuries occurring together with maxillofacial trauma and the role of trauma scoring system as a predictor of the degree of morbidity in such patients.

**Material and Methods:** A total of 1753 patients with maxillofacial injuries admitted to the department of Oral & Maxillofacial surgery Khyber College of Dentistry during a period from January 2015 to December 2017, were recruited in this study. Associated injuries and their degree of severity were determined and Revised Trauma Score applied to them. Information so collected was analyzed using SPSS version 20. One way ANOVA was used to find out the distribution of RTS among different independent variables. Odd ratios were determined for those who were referred to concerned specialty and for those referred to ICU.

**Results:** Concomitant injuries were noted in 215 (12.26%). One hundred and fifty (69.8%) were male and 65(30.2%) were female. Mean age of all the patients was 23.93±15.2 SD years. Most injuries were caused by RTA (n=119, 55.3%) followed in frequency by fall (n=47, 21.9%). Majority of the injuries were Head injuries (n=73) followed by extremities (n=56). One hundred and fifty seven (73.0%) patients were retained for maxillofacial surgical intervention while 15.3% were referred to ICU. The mean RTS for referral categories was highest among retained individuals (7.74±0.17SD) and lowest among those who were referred to ICU (6.44±0.29SD). The difference among the referral categories were statistically significant (P value <.001).

**Conclusion:** The results of the present study suggest that Revised Trauma Scoring system, strongly predicts in-hospital morbidity in patient having concomitant injuries with maxillofacial trauma.

**Key words:** Maxillofacial trauma, Concomitant injuries, Revised Trauma Score, RTS.

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## INTRODUCTION

Maxillofacial trauma is among the leading cause of morbidity and mortality in Pakistan, as isolated injury or part of poly trauma. It may be limited to superficial laceration or abrasion or associated with insult to the vital organs like brain, lungs, cervical spine and extremities. Such injuries are responsible not only for functional disabilities but also cosmetic dysfunction and subsequent psychological morbidities[1].There is a worldwide increase in maxillofacial trauma incidence; the pattern of injuries and the causes vary from one country to another depending on socioeconomic, cultural, and environmental factors. In Pakistan, the common cause of maxillofacial injury is road traffic accident (RTA) accounting for 40-50% of cases followed by assault and mandible is the most common bone fractured[2]. Worldwide, trauma is the leading cause of death in the 3rddecade of life and maxillofacial injuries

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are frequently associated with poly-trauma directly affecting the patient's quality of life if they survive. Such injuries are further complicated by the involvement of central nervous system especially brain[3]. Maxillofacial surgeons of the modern time is faced with challenges as the range of maxillofacial injuries are expanding. Potentially life threatening but less evident associated injuries can be missed or overlooked at the time of initial assessment mainly because of the severity of maxillofacial injuries[4].

Maxillofacial surgeon performing emergency services in the front line of primary evaluation of patients, who suffered fractures in the facial bones, must be aware of the fact that about 25% of patients with facial fractures have injuries in other parts of the body[5]. The prevalence of concomitant injuries worldwide ranges from 35 to 60% serving as a reminder of the acuity of these patients and the importance of a multidisciplinary approach to the trauma patients[6,7].

Different and conflicting results have been shown by a number of researchers worldwide regarding the association of traumatic head injuries with maxillofacial trauma with a prevalence of 7.6% to 8.9%[8].The resulting high-velocity impacts to the brain can cause intracranial hemorrhage[9]. Other studies have shown even higher incidence of concomitant injuries in maxillofacial trauma patients reaching up to over 90%[10]. Boego R stated that among the patient of maxillofacial trauma, cranial trauma occurred in 9.9% followed by limb fractures in 9.1%, Poly trauma was recorded in 2.3% and cervical spine injury in 3% patients[11].

Studies examining the occurrence of maxillofacial trauma and associated life threatening injuries are rare and other studies have been conducted to study the epidemiology and characteristics of maxillofacial trauma. Moreover, guidelines and tools predicting the nature of such injuries and referral criteria are rare. So the present study was conducted to evaluate the magnitude of other associated bodily injuries occurring together with maxillofacial trauma and the role of trauma scoring system as a predictor of the degree of morbidity in such patients.

## MATERIAL AND METHODS

A total of 1753 patients with maxillofacial injuries admitted to the department of Oral & Maxillofacial surgery Khyber College of Dentistry during a period from January 2015 to December 2017, were recruited in this study. Data such as age, gender, etiology, and pattern of maxillofacial injuries were determined. Associated injuries and their degree of severity were determined using initial assessment data at accident and emergency departments from where patients were referred to our department and later on the basis of assessment at maxillofacial wards. Investigations for trauma included simple maxillofacial radiographs e.g. orthopantomogram, occipitomental view, posteroanterior view face, and 3D CT scan. For associated injuries, CT scan, MRI, and US abdomen, Focused Assessment with Sonography for Trauma (FAST) and lateral cervical radiographs for cervical spine, brain, and chest and abdominal injuries and plain radiographs for extremities injuries. During preoperative analysis, Glasgow coma scale, Systolic Blood pressure and Respiratory rate were determined and documented for Revised Trauma Score (RTS) calculation. [12, 13]

RTS is a scoring system, with high reliability and accuracy in predicting mortality and morbidity. Values range from 0 to 7.8408. A score of $< 4$ has been proposed to identify those patients who should be treated in a trauma center. Scoring can be done with an online calculator or with the help of a reference chart. Information so collected was analyzed using SPSS version 20. Categorical variables such as gender, etiology, pattern and referral criteria were expressed in terms of frequency and percentage while continuous variables such as age and RTS were expressed as mean ± standard deviation (SD).

One way ANOVA was used to find out the distribution of RTS among different independent variables. In order to compare the strength of association between dichotomous or dependent variable (RTS) and independent variable (referral criteria) logistic regression analysis was performed. The goal of this analysis was to determine whether patients who were referred to concerned specialty and to ICU were more likely to be referred than other patients who were retained. The variable were divided into two levels, one variable was a score below 7 while the other was above 7.

Odd ratios were determined for those who were referred to concerned specialty and for those referred to ICU. Patients who were retained were chosen as the reference group because these patients were reported more frequently than those who were referred. Odd ratios with 95% confidence interval was estimated and difference was considered statistically significant at $p < 0.05$

## RESULTS

Among the 1753 patients with maxillofacial trauma were admitted during the study period. Concomitant injuries were noted in 215 (12.26%). One hundred and fifty (69.8%) were male and 65(30.2%) were female. Mean age of all the patients was 23.93±15.2 SD years. Most injuries were caused by RTA (n=119, 55.3%) followed in frequency by fall (n=47, 21.9%). Most of the

maxillofacial injuries occurred as mandibular fractures (27.0%) followed in frequency by zygomatico maxillary complex (ZMC) fractures (19.5%). The pattern of associated injuries were such that majority of the injuries were Head injuries (n=73) followed by extremities (n=56). One hundred and fifty seven (73.0%) patients were retained for maxillofacial surgical intervention while 33.3(15.3%) were referred to ICU. The remaining 11.6% patients were referred to concerned specialty for definitive management. The mean RTS of all patients were 7.48±0.52 SD. Baseline characteristics of the participants are given in table 1.

One way ANOVA was run to see the mean distribution of revised trauma score among different independent variables. The revised trauma score was high in occupational injury (7.80±0.05SD) and lowest in trauma as a result of fall (7.40±0.55SD). In pattern of fracture, the means score of RTS was highest among combination injuries (7.531±0.54) and lowest in dentoalveolar fractures (7.20±0.42SD). Similarly in the associated body injuries, the mean score was highest in chest injury (7.58±0.47SD) and lowest in Head injury patients (7.44±0.54SD).The mean RTS for referral categories was highest among retained individuals(7.74±0.17SD) followed by those referred to concerned specialty (7.19±0.30SD) while lowest among those who were referred to ICU (6.44±0.29SD). The difference among the referral categories were statistically significant (P value <.001) Detail is given in table 2.

**Table 1: Baseline Characteristics of the participants (n=215)**

| **Descriptive statistic of Categorical variable** | | |
|---|---|---|
| Variable | Categories | Frequency and % ages |
| Gender | Male | 150 (69.8%) |
| | Female | 65 (30.2%) |
| Cause of Trauma | RTA | 119(55.3%) |
| | Fall | 47 (21.9%) |
| | Sports | 20 (9.3%) |
| | Violence | 13 (6%) |
| | FAI | 10 (4.7%) |
| | Ocuupational | 6 (2.8%) |
| Pattern of fracture | Mandible | 58 (27%) |
| | Maxilla | 20 (9.3%) |
| | ZMC | 42 (19.5%) |
| | DAF | 4 (1.9%) |
| | Soft tissues | 18 (8.4%) |
| | Combination | 61 (28.4%) |
| | Frontonasoethmoid | 12 (5.6 %) |
| Associated Body injuries | Head Injury | 73 |
| | Cervical Spine | 30 |
| | Chest injury | 17 |
| | Abdominal visceral | 8 |
| | Extremities | 56 |
| | | 31 |
| Referred for final definitive treatment | Retained | 157 |
| | Referred to concerned specialty | 25 |
| | referred to ICU | 33 |
| Descriptive statistic of Continuous variable | | |
| Variable | Mean | Standard deviation |
| Revised Trauma Score | 7.4819 | 0.522 |
| Age in years | 23.94 | 15.287 |

**Table 2: Distribution of Revised Trauma Score**

| **Mean difference of Revised trauma score** | **Levels** | **N** | **Mean** | Std. Deviation | P value |
|---|---|---|---|---|---|
| Mean revised trauma score in different causes of trauma | Fall | 47 | 7.4 | 0.5525 | 0.162* |
| | Sports | 20 | 7.475 | 0.5739 | |
| | Violence | 13 | 7.785 | 0.0555 | |
| | FAI | 10 | 7.49 | 0.5259 | |
| | Industrial | 6 | 7.8 | 0 | |
| Mean revised trauma score among pattern of fracture | Mandible | 58 | 7.514 | 0.4861 | 0.753* |
| | Maxilla | 20 | 7.355 | 0.5799 | |
| | ZMC | 42 | 7.438 | 0.5446 | |
| | DAF | 4 | 7.2 | 0.4243 | |
| | Soft tissues | 18 | 7.494 | 0.5504 | |
| | Combination | 61 | 7.531 | 0.5424 | |
| | Frontonasoethmoid | 12 | 7.517 | 0.4282 | |
| Mean revised trauma score among associated body injury | Head Injury | 73 | 7.444 | 0.5421 | 0.95* |
| | Cervical Spine | 30 | 7.463 | 0.5385 | |
| | Chest injury | 17 | 7.582 | 0.4773 | |
| | Abdominal visceral | 8 | 7.513 | 0.5111 | |
| | Extremities | 56 | 7.498 | 0.5133 | |
| | poly trauma | 31 | 7.497 | 0.5313 | |
| Mean revised trauma score for final definitive treatment | Retained | 157 | 7.745 | 0.1763 | <.001* |
| | Referred to concerned specialty | 25 | 7.196 | 0.3062 | |
| | referred to ICU | 33 | 6.446 | 0.298 | |
| Revised Trauma Score in gender | Male | 150 | 7.501 | 0.4937 | .407** |
| | Female | 65 | 7.437 | 0.5838 | |
| Mean Revised Trauma Score in age group | up to 20 year | 106 | 7.507 | 0.5003 | 0.365** |
| | 20 to 40 years | 79 | 7.496 | 0.515 | |
| | more then 41 | 30 | 7.48 | 0.52203 | |

*One way ANOVA

**Independent sample T test

P value ≤0.05 as significant

**Table 3: Association of Revised trauma score with the Referral criteria**

| **Dependent variable Revised Trauma Score (Binary variable) Level 1: less than 07 and Level 2: More than 07)** | | | | | |
|---|---|---|---|---|---|
| Independent variable<br>Referral for final definitive treatment | Unadjusted OR<br>95% CI | P Value | Adjustment of Revised Trauma score for age and gender | adjusted OR<br>95% CI | P Value |
| Reference value( Retained) | | | Reference value( Retained) | | |
| Referred to concerned specialty | (0.047)0.005-0.472 | <.001 | Referred to concerned specialty | (0.047)0.005-0.48 | 0.01 |
| Referred to ICU | (0.001)0.000-0.008 | <.001 | Referred to ICU | (0.001)0.000-0.008 | <.001 |

Logistic regression analysis showed that odd ratios (OR) for those patients who were referred to concerned speciality was .047(95 % CI 0.005-0.472) and for those who were referred to ICU was 0.001(95 % CI 0.000-0.008). In other words, patients who were retained in the unit for maxillofacial management were not associated with greater odds of referral to concerned speciality. It can also be interpreted that patients who were retained in the unit for maxillofacial management were not associated with greater odds of referral to ICU. These results were adjusted for age and gender to know any confounding effect on outcome variable but no significant change was observed in the OR (table 3).

## DISCUSSION

Despite various preventive strategies, maxillofacial trauma remains a major health burden worldwide when occur in isolation or in combination with other body region. Because of its anatomical location, maxillofacial region is highly vulnerable to injury ranging from minor cuts and abrasions to life threatening situations[14]. Majority of these injuries are caused by road traffic crashes accounting for approximately 70% worldwide. Ogunmuyiwa SA stated that "in several developed countries, there is a downward trend of RTA related maxillofacial injuries with interpersonal violence and assault becoming the leading etiological factors".[15] In the present investigation, interpersonal violence is reported to be the fourth etiological factors of maxillofacial trauma with a frequency of 6%. Although similar to the worldwide statistics, RTA remains the leading cause of such injuries in our study.[16,17] The reason being the substandard traffic legislation and road disciplines in our country. For vigorous law enforcement standard road engineering is very important and for traffic police it is not possible to enforce lane discipline on a worn out road[17].

Department of maxillofacial surgery at Khyber College of Dentistry is one of the leading trauma center in the region and is receiving patients with maxillofacial trauma in isolation of in combination with other body injuries from different primary, secondary and even tertiary care units in the province of Khyber Phuktunkhwa and Afghanistan. Most of the time patient who has associated body injuries and requiring multidisciplinary approach before maxillofacial intervention are also referred. In our study, concomitant injuries were noted in 12.26%. According to investigators studying the association of maxillofacial trauma with other body injuries, concomitant body injuries can occur as high as 25 -36%.[5,7] Even higher percentage of the possibility of associated injuries were shown by Seher baum Eidt JM with a frequency of 60%.[7] These figures are much higher than the present study because centers and these studies were conducted are major trauma centers where patients with almost all types of injuries are primarily presented. Differences in results may also be attributed to sample size and duration of studies. Obimakinde OS while working on maxillofacial fractures stated that concomitant injuries occurred in 13.5% in their study which is in agreement with the results of our study.[18]

The finding that majority of associated injuries were head injuries (33.95%) followed by extremity injuries (26.05%) reflects the burden of severely injured patients on our unit. Variable results have been shown by different researchers worldwide ranging from 9.9% by Boego R to 55% by Scherbaum Eidt JM [11,7]. Centers where maxillofacial units are under the same roof as neurosurgical units or these units work in unison with major trauma team in the same hospital, it is difficult to document a concomitant injury among one another and is the main reason for variation in data collection[7]. Head injury is naturally associated with maxillofacial trauma ranging from minor cerebral edema and concussion to major life threatening injuries. This is because of the anatomical vicinity of head and facial region and the force of impact received at the time of injury. Normally 200-450 pounds force is required to fracture the midface, while 800-1200 Pounds is needed for frontal bone fracture when considered separately. When the force is distributed evenly over the entire face, the facial bones withstand high forces and the impact is transmitted to the skull and brain.[19]

Injury to extremities is common in RTA especially in motorcycle related accidents. Batista FS showed that in a large cross sectional study, the frequency of extremities injuries were such that, 59.66% were lower limb fractures while 40.34% were upper limb injuries.[20] In our setup, extremities injury are usually managed in orthopedic units before the patient is referred to maxillofacial surgery but still we receive approximately 26% of such injuries. This second frequent presentation in our study may be attributed to the fact that such injuries are either left unnoticed or the patient is presented directly from the site of accident to maxillofacial unit. Whatever the reason may be, the fact remains that such injuries if presented primarily are usually referred to the concerned specialty for definitive management. Because once the facial fractures are managed, patients are kept in mandibulo-maxillary fixation and pose a difficulty for the anesthetist in the respective unit if intubation is needed for management of such injuries[20]. The mean RTS score was highest in chest injury (7.58±0.47SD) and lowest in patients with head injury (7.44±0.54SD) in the present study. As mentioned earlier, the RTS is a physiological scoring system and is heavily weighted towards the Glasgow Coma Scale (GCS).[13] Therefore mild to moderate type of head trauma may greatly influence the results of this scoring system. As majority of the patient with associated body injuries in our study were head injury patients (33.95%), the GCS levels might have influenced the RTS scoring.The mean RTS for referral categories was highest among retained individuals (7.74±0.17SD) followed by those referred

to concerned specialty (7.19±0.30SD) while lowest among those who were referred to ICU (6.44±0.29SD). The difference among the referral categories were statistically significant (P value <.001). Maxillofacial trauma management during the golden hour of injury is very important and determines the future outcome. A valid and tested trauma scoring system helps the trauma care physician regarding the degree of severity of injuries and subsequent management at a particular unit[21]. Although many investigators showed that RTS is a time consuming and poor predictor of the actual severity of injury but others have also shown that the use of trauma scoring systems is appropriate in situations where a decision is to be made whether to retain the patient in maxillofacial unit or to send the patient to a multidisciplinary trauma center where intensive care unit can be provided as well[22].

Rathore S while working on 2541 trauma victims stated that the overall mean RTS score was 7.67 ± 0.77 and significantly lower RTS scores were recorded among those who were seriously injured and a mean RTS of 4.59 ± 2.09 in those who expired soon after.[23] They showed that those who survived and were retained for definitive treatment, their mean RTS was 7.76 ± 0.445. Similar results were shown by other researchers across the world namely Koo M, Kuhls DA and Norouzi V and were of the opinion that RTS can be incorporated as a quick reference tool for the prediction of morbidity and injury severity.[24-26]

Incorporating RTS system in primary and secondary surveys will help the maxillofacial surgeon to formulate referral criteria for definitive management. The government of Khyber Pukhtukhwa should take concrete steps for establishing a well-equipped full time Maxillofacial surgical ICU for the severely injured patients managed at department of Maxillofacial Surgery at Khyber College of Dentistry. Presently the department is sharing the ICU facility with Khyber Teaching Hospital in the premises. This will further improve the level of care of patients with maxillofacial trauma and will reduce the number of referral to other hospitals for intensive care. The main limitation of this study is: the design of the Revised Trauma Score system is such that it is weighted towards the Glasgow Coma Scale even in the absence of multiple injuries or physiological body responses to injury. Therefore high frequency of Head injury patients and their low GCS scores in our study may have influenced the final results.

## CONCLUSION

Majority of associated injuries were head injuries with lowest RTS. Statistically significant difference was found in mean RTS among those patients who were retained, referred to concerned speciality and those who were referred to ICU. This study suggests that Revised Trauma Scoring system, strongly predicts in-hospital morbidity in patient having concomitant injuries with maxillofacial trauma.

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## AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

| | |
|---|---|
| **Rehman B:** | Principal Author, main idea, study designing, supervision. |
| **Khan M:** | Acquisition of data, manuscript drafting. |
| **Ali F:** | Data analysis and data interpretation. |
| **Rehman AU:** | Literature review. |
| **Ahmad T:** | Data collection, proof reading. |
| **Shafi H:** | Data acquisition, systemic review. |
| **Sulaiman M:** | Data collection, Bibliography, Endnote referencing. |
| **Ansari SR:** | Overall supervision, Final drafting. |

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.