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SHOCK WAVE PROPAGATION THROUGH ATYPICAL CONTRA-FORCES IN THE MAXILLOFACIAL REGION AFTER ELECTRIC SCOOTER USE

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Abstract
Objective: To determine the role of contra-forces in external pathological impacts that result in fractures of the upper and lower jaws.

Keywords: Road traffic accidents, individual mobility means, fractures, maxilla, mandible, combined, non-combined injuries.

Introduction

Relevance

The use of individual mobility devices such as electric scooters has been rapidly increasing, and so has the number of injuries, including those to the maxillofacial region. Studying the propagation of shock waves through atypical contra-forces in this area after electric scooter use can help in understanding the mechanism of injuries and developing prevention and treatment methods.

Current research indicates an increase in head bone injuries resulting from road traffic accidents. According to a 2022 study by the James Jameson Institute of Trauma, there were over 1000 such cases reported from 30 emergency departments across Queensland, Australia, with an additional 558 cases reported by the end of May 2023 involving electronic scooter-related incidents. Social media observations in the city of Tashkent, Uzbekistan, show the use of electronic scooters in inappropriate places, with users often unfamiliar with traffic rules, exacerbating the risk of road traffic accidents.

The prevalence of individual mobility devices, specifically electronic scooters, has been increasing worldwide due to their convenience and accessibility. However, this has also led to a rise in road traffic accidents (RTAs) involving these devices.

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According to official data from the Road Safety Department of the Ministry of Internal Affairs of the Republic of Uzbekistan, there has been an increase in injuries to the maxillofacial region (MFR), particularly the upper and lower jaws, resulting from RTAs involving electronic scooters. The pathological perception and distribution of shock waves by the buttresses (structural reinforcements) of the jaws during these accidents contribute to these injuries. The maxilla has four buttresses that distribute occlusal forces evenly: the frontal nasal buttress, the alveolar maxillary buttress, the pterygoid palatine buttress, and the palatine buttress. The mandible has two buttresses: the ascending ramus and the alveolar process, which distribute physiological forces generated during mastication. Pathological exogenous impacts on these buttresses, such as blows, can result in fractures at specific locations where the bone structure is less dense.

Materials and Methods

This study was conducted at the Tashkent State Dental Institute, involving patients who sought professional medical and surgical help at the emergency surgical department with maxillofacial injuries (MFI). Patients with lacerations, contusions, and skull fractures, particularly of the upper and lower jaws, with both combined and non-combined injuries were examined.

The study investigated the trajectory of shock wave distribution and deviation by buttresses and its significance in MFI. To determine shock wave deviation, experimental re-creation of the moment of impact, force, speed, trajectory, and the plane of impact were used, along with the localization of the head injury. Materials, such as a cylindrical tube with a smooth surface, length 1m, outer diameter 21.3 mm, and wall thickness 2.8 mm, uneven ground with gravel, and asphalt, were selected for the practical part of the study.

The experiment was conducted in various locations with different combinations, including ditches 30 cm deep and 40 cm in diameter, uneven and smooth asphalt surfaces. Each material was obtained through specific methods. For instance, the cylindrical water-gas pipe was obtained from a market and cut to the desired length of 1m. The study was conducted in the vicinity of the Tashkent State Dental Institute to mimic real-life accidents involving electronic scooters.

Results

The theoretical and practical parts of the study showed that upon impact on the lateral surface of the zygomatic area, the deviation and distribution of the impact occurs in three directions:

1. Along the zygomatic arch towards the temporal bone, resulting in a fracture at the junction of the zygomatic process of the temporal bone and the zygomatic process of the maxilla, involving the zygomatico-alveolar buttress.
2. Along the apical arch at the level of the root apices, leading to a fracture in the same direction, starting from the tuberosity of the maxilla towards the lower part of the pterygomaxillary fissure, which may result in a combination of fractures, such as an alveolohorizontal fracture of the maxilla and a fracture of the orbital floor. In this case, the shock wave is distributed from the zygomatico-alveolar buttress towards the frontal nasal buttress, with deviation towards the atypical parts of the buttresses located on the lower wall of the orbit and the apical arch of the maxilla.
3. Along the zygomatic bone towards the lower wall of the orbit.

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Moreover, experiments involving impacts and falls on a flat surface from the front of the head predicted possible fractures according to the Le Fort classification (types I, II, and III), indicating the severity of the injury. In cases of mild injury, nasal bone fractures may also occur. The point of impact may be the body of the maxilla or the frontal process of the maxilla. In Le Fort I fractures, the line of fracture runs horizontally at the junction of the alveolar process and the body of the maxilla, extending from the lower wall of the pterygomaxillary fissure towards the tuberosity of the maxilla. The direction of other Le Fort fractures depends on the severity of the fracture and the direction of the pathological impact of the shock force on the skull bones.

Conclusion

The severity and localization of fractures depend on the force of impact, shock wave trajectory, initial point of contact, and the surface of collision. The widespread use of electronic scooters, scooters, and other individual mobility devices without proper driving knowledge and protective gear significantly contributes to maxillofacial injuries, with many accidents involving children. To reduce road traffic accidents and prevent maxillofacial injuries, it is recommended to:

- Implement specific purchase and usage criteria for individual mobility devices for minors, and involve parental responsibility in enforcing these criteria and preventing violations
- Recall that, besides the skull bones, the brain and numerous blood vessels are present in the head, and their damage can be fatal

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