Dynamic response analysis of the mechanism of mandible trauma.

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Abstract

Mandible fractures are the most common disabling injuries among the facial trauma.Clinical observation found that the usual sites of the mandible fractures aresubcondyle region, mandibular angle, parasymphsis, mandibular body, alveolarprocess, ascending ramus and coronoid process. In traumatic biomechanical analysis, traumatic injuries typically result from an impact force by a hard object. Such impact forces are, in general, of short duration (1-20ms) and most probably give rise to a vibrational response, superimposed on rigid body motion of the impact tissue. Since dynamic response analysis is an important basis for analyzing the mechanism of trauma, to evaluate the possibility for vibrational assessment of mandible, in this study, resonance frequency (RF) are carried out to be a parameter for assessing the relationship between dynamic behavior of mandible and mandible fractures. Ten mandibles positioned on a soft cushion to provide free-free boundary condition were tested by modal testing method. Each mandible was triggered to vibrate by an impact hammer at 7 points which were designed by the clinical fracture site. Then the RF values and vibration mode were recorded. Our results showed that the RF values fall between 560Hz and 598Hz with a mean of 578.6 ±11.67Hz. Then, RF value of the finite element (FE) modal was calculated as 567.3 Hz which is only 1.9% smaller then the results of in vitro test. That is, the FE modal was validated as a credible modal for dynamic response analysis. The RF value of fresh mandible was then calculated as 501.4 Hz using FE modal. The result was also indicated that the middle area of mandible body is probably a nodal position where bone fracture is less likely to happen. On the contrary, the greatest amplitude was found in the parasymphysis of the mandible and the subcondyle region where bone fracture are prone to occur. These findings corresponded to the probable site of fracture of the mandible usually seen in clinical practice. The results obtained from this study will provide an insight into the basic dynamic properties of human mandible. These experimental results will be an useful reference for future advanced experiments and protective guard design.