비침습적 인공호흡 마스크의 가상 착의 평가

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Virtual Fit Analysis of Non-invasive Ventilation (NIV) Mask Design

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ABSTRACT

Objective: The present study aimed to analyze the virtual fit of non-invasive ventilation (NIV) mask-wearing of patients with bulbar amyotrophic lateral sclerosis (ALS) for ergonomic mask design. **Background:** Bulbar ALS patients have larger morphological deformation of the face by posture than the healthy, which may cause a higher risk of NIV mask-related side effects such as pressure injuries and air leaks. Method: The virtual fits of an NIV mask in patients in three different postures were compared with the healthy in sitting posture. Four steps, including (1) acquisition of 3D data, (2) identification of mask-wearing position, (3) measurement of the horizontal distance, (4) analysis of mask fit, were performed. First, the 3D faces of 10 bulbar ALS patients (age: 59.2 ± 12.8 years) and 10 healthy subjects (age: 32.5 ± 13.2 years) were scanned in three postures, including sitting, supine, and lateral (left) postures. 3D data of 3 healthy subjects with properly donned NIV masks and the NIV mask were obtained. Second, the optimal mask-wearing position of 20 participants was identified based on the average horizontal distances of the mask to 3 healthy subjects. Then, the filtrations between 16 key landmarks of the face and the corresponding landmarks of NIV masks were measured using Rhino 3D (Robert McNeel and Associates, Seattle: WA, USA). Last, the horizontal distance of patients in three postures was compared with that of the healthy subjects in sitting posture. **Results:** In bulbar ALS patients, the fit of the mask was reduced by 21.0% at bilateral lower sides of the chin and increased by 24.6% at promentale compared to the optimal fit. In supine posture, mask fit was significantly reduced by 13.2% ~ 44.2% in the left and right cheeks and nasolabial folds. In lateral posture, the mask fit significantly decreased by 20.2% ~ 33.9% in the left cheek and increased by 9.6% at promentale and 10.9% in the upper right cheek. **Conclusion:** Unfit of NIV mask of bulbar patients in sitting, supine, and lateral posture was identified by virtual fit analysis. **Application:** Virtual fit analysis is applicable to provide quantitative evidence in the ergonomic NIV mask design process.

Keywords: Mask Design, Virtual Fit, Non-Invasive Ventilation (NIV), Posture