PPF002: Poster presentation

Evaluation of the Leakage Test Methods for Exhalation Valve

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Abstract

An ideal tight-fitting full mask with exhalation valve has features of low impedance during exhalation and comfort when worn for a long period of time. The valve normally fits tightly to the base by vacuum created during inhalation; however, leakage could occur when the valves and their bases were defective from the manufacturing process. To date, the only approach to detect leakage and ensure the effectiveness of the masks is to examine every exhalation valve, which can be time-consuming. Therefore, the aim of this study was to first compare across different fit testing procedures and subsequently develop a more time efficient test.

Current leakage test methods include (a) drainage collection, (b) flow rate monitoring, and (c) pressure decay. The differential pressure system was newly developed in this work, which included a solenoid valve, a flow meter, a suction pump and a pressure gauge. Leakage was determined by monitoring the change in the negative pressure of the testing system which, in theory, varied with the leak flow rate. The experimental parameters included vacuum chamber sizes (10-100 cm^3), reaction pressure (10-150 mmH_2O), suction flow rate (0.5-30 L / min) and the size of the testing tube. The drainage collection method was then used as a reference method for comparison.

Results showed that the response time of the drainage collection method was approximately 15-20 seconds. The pressure decay method had shorter response time (~2 seconds) for small chambers and high leak flow rate. For differential pressure method, both response time and pressure difference decreased with increasing suction flow rate, when tested under the same leak flow. Consequently, a suction flow rate of 0.4 L/min was recommended to ensure detectable pressure difference when sampled under leak flow of 30 ml/min (@ 25 mmH_2O), with a response time less than 1.2 seconds. Furthermore, response time was almost identical between the flow rate monitoring method and differential pressure method, because they operated on the same theory and leakage detection condition (<50 ml / min at 25 mmH_2O). When comparing among these methods, the differential pressure method was more time efficient compared to the time needed for the complex operating procedure of the flow rate monitoring method and the longer recovery time from the pressure decay method.