

## ICES 2015 Abstract

### Spacesuit Glove-Induced Hand Trauma and Analysis of Potentially Related Risk Variables

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Injuries to the hands are common among astronauts who train for extravehicular activity (EVA). When the gloves are pressurized, they restrict movement and create pressure points during tasks, sometimes resulting in pain, muscle fatigue, abrasions, and occasionally more severe injuries such as onycholysis. Glove injuries, both anecdotal and recorded, have been reported during EVA training and flight persistently through NASA's history regardless of mission or glove model. Theories as to causation such as glove-hand fit are common but often lacking in supporting evidence. Previous statistical analysis has evaluated onycholysis in the context of crew anthropometry only (Opperman et al 2010).

The purpose of this study was to analyze all injuries (as documented in the medical records) and available risk factor variables with the goal to determine engineering and operational controls that may reduce hand injuries due to the EVA glove in the future. A literature review and data mining study were conducted between 2012 and 2014. This study included 179 US NASA crew who trained or completed an EVA between 1981 and 2010 (crossing both Shuttle and ISS eras) and wore either the 4000 Series or Phase VI glove during Extravehicular Mobility Unit (EMU) spacesuit EVA training and flight. All injuries recorded in medical records were analyzed in their association to candidate risk factor variables. Those risk factor variables included demographic characteristics, hand anthropometry, glove fit characteristics, and training/EVA characteristics.

Utilizing literature, medical records and anecdotal causation comments recorded in crewmember injury data, investigators were able to identify several risk factors associated with increased risk of glove related injuries. Prime among them were smaller hand anthropometry, duration of individual suited exposures, and improper glove-hand fit as calculated by the difference in the anthropometry middle finger length compared to the baseline EVA glove middle finger length.