SHOULDER INJURY INCIDENCE RATES IN NASA ASTRONAUTS
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INTRODUCTION
Evaluation of the astronaut shoulder injury rates began with an operational concern at the Neutral Buoyancy Laboratory (NBL) during Extra Vehicular Activity (EVA) training. An astronaut suffered a shoulder injury during a NBL training run and commented that it was possibly due to a hardware issue. During the subsequent investigation, questions arose regarding the rate of shoulder injuries in recent years and over the entire history of the astronaut corps. The purpose of this study is to determine the incidence rate of shoulder injuries incurred by active duty NASA astronauts and determine if the rate of injury has changed over time.

METHODS
Astronaut medical records were queried from the NASA Johnson Space Center (JSC) Flight Medicine Clinic and all shoulder and upper arm orthopedic conditions were noted. An injury was considered directly attributed to EVA training if the all following conditions were met:

• The astronaut performed EVA training in the WETF or NBL
• The injury occurred while considered an active astronaut at NASA
• The NBL, Weightless Environment Training Facility (WETF), EVA suit or EVA training was associated with the injury in the medical record.

To determine the rate of injuries over the course of NASA history, astronauts were categorized according to the decade in which they were selected as astronauts. Since the first astronaut class selected in 1959 included only seven individuals, they were grouped with the astronauts selected in the 1960’s. Shoulder injury incidence rates were calculated and reported as the number of injuries per 100 crew members over 10 years of active duty. Overall incidence rates were then stratified by sex and selection decade.

RESULTS
All astronaut medical records were queried (n=330) and a total of 40 injuries met the strict definition of shoulder injury associated with EVA training through December, 2012. The overall shoulder injury incidence rate was 9.67 injuries per 100 astronauts over 10 years. Although the differences are not statistically significant, the rate for males was slightly lower at 8.88 and females slightly higher at 13.97. The injury rates by selection decade show a dramatic increase in injuries attributed to EVA training, however these differences are statistically non-significant likely due to the small population size.

CONCLUSION
Although the incidence rates of shoulder injuries appear to be increasing over the years, the requirements of the astronaut corps has also changed. All astronauts are now expected to be EVA certified in order to fly whereas that was not a requirement for earlier astronauts. In order to better understand the magnitude of the astronaut shoulder injury rates, future studies using a cohort population with similar traits will be performed.