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# Aircrew Neck Pain: An International Challenge

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# Disclaimer

The opinions, interpretations, conclusions, and recommendations are those of the presenter and are not necessarily endorsed by the U.S. Army and/or the U.S. Department of Defense.

I have no conflicts of interest to report.

# Neck Pain in the General Population

- 4<sup>th</sup> leading cause of disability worldwide
- Half the population has clinically important neck pain each year
- Annual prevalence varies by country – some as high as 66%
- Lots of studies



# Risk Factors Associated with Neck Pain

- Previous MS pain
  - High job demands
  - Low social support
  - Job insecurity
  - Poor workstation design
  - Sedentary work position
  - Repetitive work
  - Precision work
  - **Age**
- (and weakly...
- Gender
  - Occupation
  - Headaches
  - Emotional problems
  - Smoking
  - Awkward work postures
- ✓ Interactions among the above



“Tech Neck”

# Neck Pain in Aviation

- Well known in fixed-wing fighter pilots
- Helicopters more known for low back pain
- 1990's – more neck pain in RW pilots



# Characteristic Patterns of Neck Pain



- Acute
- Linked to specific injurious event
- G-related



- Chronic
- Gradual onset
- Recovery between flights



# Characteristic Patterns of Neck Pain

Fixed Wing Fighters



- Acute
- Linked to specific injurious event
- G-related

Both groups can develop severe chronic disease

Rotary-Wing



- Chronic
- Gradual onset
- Recovery between flights

# Neck Pain Patterns Blur

Fixed Wing Fighters



- More helmet-mounted equipment

Rotary-Wing



- More agile helicopters

# Neck Pain in High Performance FW

- 1959 – First reported case
  - Flexion injury after +9z emergency pullout
- Well-documented in literature
- 1980's – more frequent reports
  - Norwegian flight surgeon injury well-documented

# Neck Pain in High Performance FW

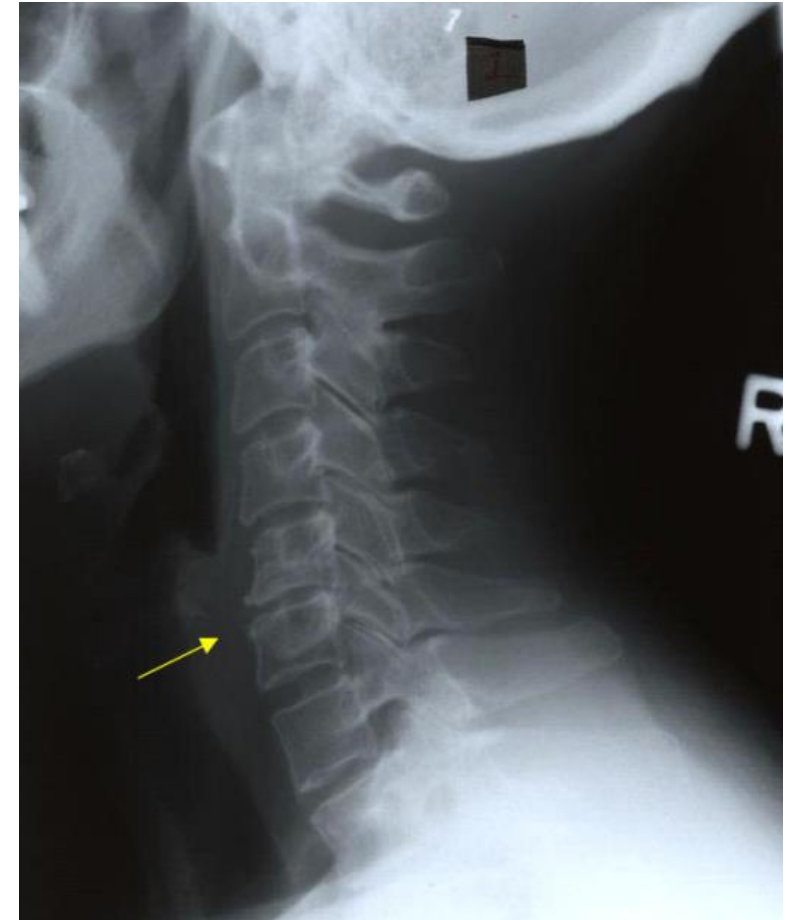
- 1988 – 74% of FA-18 Navy pilots w hx
- 1989 – 50% of USAF pilots in prev 3 months
- 1997 – 84% RAAF w hx
- 2008 – 70% RAF w hx
- 2011 – 95% RAAF in past year
- 2012 – 72% Norwegian fighter pilots
- 2017 – 60% French fighter pilots

# Risk Factors for Fighter Pilot Neck Pain

- F-16 – Multiple reports of increased risk 1990's
  - 2004 – speculation that seat requires more neck muscle activation
- F-15 – Reports of increased neck problems (1995)
- MiG-29 – Associated with more neck symptoms vs MiG-23 (1999, 2008)
- 2017 – 61% CF-188 and CT-155 pilots
- 2018 – Mayes, Lindsay, Turner report ???

# Chronic Neck Disease in Fighter Pilots

- Age is very strong risk factor
- Two NATO panels (1999, 2008) concluded that flying fighters has an adverse effect on c-spine
- Confirmed by one 2015 meta-analysis
- Another meta-analysis in 2015 found association only with the highest levels of G-forces
  - Authors criticized previous studies for failing to adjust for age and other risk factors



# Neck Pain in FW Transport Pilots

- 1999 – 78% of E-2C Hawkeye turboprop pilots in previous year
- 2014 – USAF long-haul pilots at increased risk
  - Related to posture and vibration?
- Neck pain does not appear to be widespread
  - Could change with tactics and equipment

# Neck Pain in Helicopter Pilots

- 1998 – 29% Australian 1-year prevalence
- 2006 – 57% Swedish pilots 3-month prevalence
- 2008 – 57% RAF w hx
- 2008 - ~21% Indian w sx
- 2010 – 43% Netherlands 1-year prevalence
- 2011 - 62% US Army w hx, 30% frequently
- 2004, 2016 – 80%, 75% Canadian with hx
- 2012 – 47% Israel with sx
- 2013 – 58% US Navy with significant inflight pain



# Neck Pain in RW Rear Crew

- 2008 – 71% UK rear crew w hx
- 2011 – 65% Canadian engineers w sx
- 2012 – 62% Netherlands rear crew 1-yr prevalence
  
- An increasing concern

# Chronic Neck Disease in RW Pilots

- 2004 - RW pilots at higher risk than other pilots but age greatest factor
- 2013 – RW pilots had more degenerative changes, which correlated with flight hours
- Age continues to be strong factor

# Age vs Occupational Exposure



# Age vs Occupational Exposure



# Neck Pain and Head-Supported Mass

- 1990s – Several studies demonstrated increased muscle work with increased helmet mass
- 2012, 2016 – EMG and computer models suggest higher risk of neck pain
- 2016 – Counterweights can increase muscle work; benefit probably task dependent
- 2006, 2011 – Multiple authors have found various correlations between NVG exposure and neck symptoms but complex



# Operational Impact

- Symptoms can range from trivial to incapacitating
- Aeromedical concerns: inflight pain and reduced range of motion
- Effect of pain on performance is difficult to study
- Pain has been shown to degrade task performance, esp complex tasks and multi-tasking



# Operational Impact

- 1990 – Reported case of G-related spasmodic torticollis
- 1997 – 50% F/A-18 pilots had neck pain interfere with mission completion
- 2011, 2017 – Neck pain interferes with ‘check-six’ in fighter pilots
- 2013, 2014 – Range of motion degraded in helicopter pilots with neck pain
- Common sense must prevail in absence of well-controlled studies



# Conclusions

- Overwhelming weight of poorly-controlled studies in operational setting
- Flying fighter aircraft is established as risk factor for acute neck pain
- Increased head-supported mass appears to correlate with increased muscle work and patterns of neck pain
- Chronic neck disease is difficult to separate from other factors, especially age



# Conclusions

- Nonetheless, neck pain is endemic in military aircrew, and solutions are needed
- Operational studies should be standardized to better understand risk factors and countermeasures
  - Survey
  - Methods
  - Pooling of data

# Way Forward

- Persistent problem in aircrew led to NATO Panel 252, “Aircrew Neck Pain”
  - Presented broad range of issues at AsMA 2018
  - Another panel planned for AsMA 2019
  - Panel report due out in Feb 2019

# Highlights of Recommendations

*(Crowley Version)*

- The Professional Athlete Model is becoming the Gold Standard for prevention of neck pain and general performance optimization in aircrew
  - Big role for physiotherapy
  - Data is needed to support
- Helmet characteristics are critical but not well-defined
  - Research is underway
- Helmet fit is more important than recognized
- Aircrew jobs should be optimized to minimize musculoskeletal stress
- Key Products to Improve Global Research:
  - Standardized survey questions
  - Standardized definitions of pain characteristics



# Questions?

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