

Shoulder Dislocation CLIFF Peer Review

1. *Strength of evidence presented in CLIFF in modeling the characteristics and mission impact of this medical condition within the spaceflight environment?*

Score: 3

Grading Scale:

4 - *Confident*

3 - *Somewhat confident*

2 – *Neutral*

1 – *Somewhat unconfident*

0 – *Not confident*

2. How confident are you that these data accurately represent the spaceflight environment?	Tables 1, 2 Composite Incidence and Level of Confidence	Table 3, 4 BC/WC Loss of Crew and probability	Table 4 - Clinical Phase 1, 2 durations Table 5 – CP 2 Loss of Crew	Table 4 – RTDC % Table 6 – RTDC Loss of Crew	Table 4 – Loss of Crew Life % Table 7 – Loss of Crew Life, Loss of Crew	Table 8 – TI
Score	3	3	3	3	3	3

Comments and limitations:

1. General comments. Shoulder dislocation occurs when the humerus moves out of the glenohumeral joint capsule. Anterior dislocations occur in about 95% of cases. Posterior dislocation and inferior dislocations are much less common. Most dislocations are associated with forceful trauma such as sports injuries, motor vehicle accidents or falls on an outstretched hand. Spontaneous dislocations do occur but generally in younger individuals (<30 yo). Since it is highly unlikely that the forces necessary to cause a dislocation could be generated in microgravity and that the average age of current astronauts is 48, the probability of a microgravity shoulder dislocation is presumed to be near zero. Thus, the risk assigned to this CLIFF only applies during surface EVA ops in partial gravity environments. There have been no reports of shoulder dislocation during spaceflight.

2. Incidence. As stated above the risk of microgravity dislocation is assumed to be close to zero; therefore, an incidence proportion was assigned for surface EVA's. A single terrestrial paper was chosen to inform the probability distribution as its demographics were thought to best resemble those of the current astronaut corps. The incidence proportion is extremely low, as would be

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expected. The best case/worst case probability was based on the median value for recurrence in a population age-matched to astronauts, as reported in a meta-analysis. The clinical phase durations, RTDC (based on the risk of neurovascular injury) and Loss of crew life probabilities are supported by terrestrial evidence. The probability density curve that was derived appears to be a reasonable representation of the data presented.

3. Clinical phase data. I am in agreement with the clinical phase 1 duration entered in this CLIFF. This data was compiled by a team of expert clinicians, and I was involved in the discussions leading to the calculation of the clinical phase durations. CP2 duration is supported by terrestrial evidence and is explained in more detail in Tab 9B of the CLIFF.

4. Task impairment. The analysis was performed and reviewed by a separate team of expert clinicians. I am aware of the methods that were used but did not directly participate in the discussions.

5. Dependence on mission phase or duration of mission. This medical condition is dependent on mission phase and only applies during surface EVAs for IMPACT 1.0.

6. Limitations

- Much of the data used to inform this CLIFF is based on articles with populations under the age of 20 years old (particularly clinical phase duration data). The management of first-time shoulder dislocations is very different depending on age. Those under the age of 30 have a much higher risk of recurrent dislocation due to instability. Thus, surgical management is typically indicated in this young population. Those over age 30 (like our astronaut crewmember population) are not at as high of a risk for recurrence due to instability, so first-line treatment is reduction followed by immobilization (not surgery). To the extent possible data was used that studied populations of age 30 and over.
- RTDC was assumed to be 0% by the clinical team for best-case scenarios. Despite this, a search was performed for the untreated best-case scenario that yielded multiple results, but they were disregarded based on the assumptions made by the clinical team.
- All Loss of crew life values for scenarios other than best-case treated scenario are based on the best-case treated scenario search results. No Loss of crew life searches were run for the other scenarios.
- This CLIFF will need to be updated to include non-EVA surface operations after IMPACT 1.0.

Reviewed by:

David C. Hilmer