

Dental Luxation Avulsion 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	2	3	3	3	3	3

*** Excellent, accessible data from the European spine registries as well as non-

Comments and limitations:

1. **General comments.** Dental luxation (displacement of a tooth without loss) and avulsion (complete tooth loss) are usually caused by trauma to the mouth and are the subject of this CLIFF. They most frequently occur in the pediatric and young adult population, are more likely in males, and often occur in non-permanent teeth. Although luxation/avulsion has never occurred before in spaceflight, the standard of care has been expectant management without splinting or reimplantation of the avulsed tooth with symptom control including pain management and control of bleeding. In microgravity, the forces needed to cause such an injury are unlikely to be generated and safety measures to prevent luxation or avulsion have been engineered into on-board systems. During partial gravity, gravity well, and launch/landing operations, helmets provide protection to the oral cavity. Astronauts have been trained to avoid movements that would result in dental injury. Thus, the use of terrestrial and analog data, while robust, most likely overestimates the incidence of this medical condition.

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2. Incidence. Since there have been no reports of dental luxation and avulsion in space, terrestrial and analog data was utilized. It was challenging to find studies that specifically examined the conditions defined in this CLIFF. Looking across studies it was found that approximately 75% of oral injuries were avulsions/luxations. This estimate was applied to studies that reported incidence in terms of general mouth injuries. Data from three studies were combined to calculate a composite incidence. It was difficult to find data that matches the astronaut demographics and spaceflight environment. For the reasons stated in the general comments, it is felt that the calculated incidence, while supported by terrestrial data, will be a substantial over-estimate of the incidence in flight. For example, the calculated incidence would predict an occurrence of this medical condition within 45.7 person-years of spaceflight, yet there has not yet been a single case in about 50 person-years. The best case/worst case probabilities, clinical phase durations, RTDC and Loss of crew life probabilities are supported by terrestrial evidence, and I am in agreement with their calculation. The probability density curve that was derived appears to be a reasonable representation of the data presented. Because of their large sample size, the studies used to compute the composite incidence result in a tight variance that most likely overestimates the confidence we have in the assigned value.

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 duration. CP2 was supported by terrestrial evidence.

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 should not be dependent on mission phase.

6. Limitations

- While there is robust evidence to determine the incidence of traumatic dental injuries terrestrially and in analog populations, there have been no reports of dental injuries during spaceflight.
- The calculated incidence, while supported by terrestrial data, is likely to be a substantial over-estimate of the incidence in flight, particularly in microgravity. The calculated incidence predicts an occurrence of this medical condition within 45.7 person-years of spaceflight, yet there has not yet been a case in about 50 person-years.
- Most studies evaluate dental injuries more broadly than just luxation and avulsion; thus, an estimate was made of the percentage of dental injuries that result in subluxation/avulsion.
- Many dental injuries occur in non-permanent teeth, and while we attempted to select for specific incidence of permanent teeth, this incidence estimation may be conservatively elevated.
- Because of the large sample size, the study used to compute the composite incidence most likely overestimates the confidence we have in the assigned value.
- The best case and worst case definitions consider pain and bleeding, which is reasonable. However, there is a paucity of literature specifically evaluating and reporting on the incidence or duration of such complications.

Reviewed by:

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David C. Hilmers