Risk assessment of aviators with a total hip arthroplasty

Max Talbot ,[1,2] M Gear,[3] J Young,[3] D Milner,[3] A Bunting,[2] A Bozzo[2]

Military pilots occasionally return to flight status following a total hip arthroplasty (THA), but a structured approach to evaluate the operational risk associated with this condition has not been established.[1 2] All-cause revision rates provided by national arthroplasty registries are not good indicators of operational risk. For example, aseptic loosening does not present an acute threat to flight operations. We propose a novel approach to evaluate the operational risk of aircrew with a THA.

Periprosthetic fractures and hip dislocations are the main causes of operational risk for aircrew with a THA. Until recently, their incidence was difficult to predict but nomograms now allow individualised forecasts for the first 5 years after the index procedure.[3 4] The projected injury rates can be combined with aviation risk matrices to evaluate individual aircrew.[5] Synthetic cases will illustrate our approach and highlight that superficially similar aircrew can have widely different levels of operational risk. Take, for instance, two healthy 50-year-old female maritime helicopter pilots who require a THA. Both have a BMI of 25 and normal bone mineral density. Pilot A has primary osteoarthritis, but Pilot B has avascular necrosis. Pilot A receives an uncemented THA with a 32 mm ceramic head, a collared stem, and a neutral highly crosslinked polyethylene (XLPE) liner through an anterior approach. Pilot B gets the same implant, but through a posterior approach.

We would advise against a return to full duties in the first year after surgery because this period has the highest incidence of complications. In addition, patients need extended rehabilitation to meet military operational fitness standards. Therefore, the rate of injury after the first postoperative year is the most appropriate measure of operational risk. The nomograms allow us to estimate that Pilot A has a 0.3% yearly risk of fracture and dislocation (combined) after the first year, which makes her 'green' on the Canadian Armed Forces aeromedical risk matrix (table 1).[3 4] In contrast, Pilot B has an estimated 0.8% annual risk of fracture and dislocation, making her 'yellow' on the risk matrix (table 2).[3 4] The risk to flight safety is probably less than these estimates suggest, as fractures and dislocations are unlikely to occur in the cockpit. However, they could occur during pre-flight activities and compromise the mission.

Our approach has limitations. The models underlying these estimates are based on a single large institutional arthroplasty registry and need to be validated on external data sets. In addition, the risks associated with extreme aviation events (eg, ditching) are not captured by the nomograms. Despite these limitations, we believe that the new nomograms are currently the best method to evaluate the risk of acute injury in aircrew with a THA. Artificial intelligence may soon provide even more precise risk estimates by analysing imaging in addition to clinical features. We encourage continued research in this promising field in order to improve personalised risk assessments for aircrew with a THA.

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Table 1 The Canadian Armed Forces aeromedical risk matrix risk applied to Pilot A

	Medical event class			
Incidence	1	2	3	4
Likely (>2%/y)				
Possible (>1–2%/y)				
Unlikely (>0.5–1%/y)				
Highly unlikely (<0.5%/y)		Aseptic loosening	Deep infection	Acute injury

We consider periprosthetic fractures and dislocations to be class 4 medical events as they would be 'likely to result in a flight safety critical event' if they occurred during flight. Acute injury=combined incidence of dislocation and periprosthetic fracture. Risk matrix adapted from Grey *et al*.[5]

Table 2 The Canadian Armed Forces aeromedical risk matrix risk applied to Pilot B

	Medical event class			
Incidence	1	2	3	4
Likely (>2%/y)				
Possible (>1–2%/y)				
Unlikely (>0.5–1%/y)				Acute injury
Highly unlikely (<0.5%/y)		Aseptic loosening	Deep infection	

Acute injury=combined incidence of dislocation and periprosthetic fracture. Risk matrix adapted from Grey *et al*.[5]

[1]Department of National Defence and the Canadian Armed Forces, Montréal, Québec, Canada
[2]Department of Surgery, McGill University Health Centre, Montréal, Québec, Canada
[3]Department of National Defence and the Canadian Armed Forces, Ottawa, Ontario, Canada

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ORCID iD
Max Talbot http://orcid.org/0009-0004-3976-1541

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