

FLYING AFTER DIVING

RECENT CHANGES TO RECOMMENDATIONS

by Dr Lynn Taylor (PhD, BSc)

Current at time of writing (2003)

This article is an educational update giving the latest recommendations for the minimum pre flight surface interval (PFSI) when 'Flying after diving'. Also available on this NZUA website is a case study taken from the NZUA dive incident database, which is used to illustrate the correct action to take if symptoms do occur on a flight after diving¹.

Divers are taught in their training that flying (or otherwise ascending) to a higher altitude after having dived can predispose a diver to decompression sickness (DCS) unless there has been sufficient surface interval to allow excess gas to diffuse out of the body. If insufficient time has been allowed and the ambient pressure is reduced, gas bubbles may form, or existing asymptomatic bubbles may increase in size and cause symptoms of decompression illness². But how long is a sufficient surface interval and how were the guidelines determined?

Until recently, the flying after diving guidelines dated from an Undersea and Hyperbaric Medical Society (UHMS) meeting in 1991. In May 2002, DAN (Divers Alert Network) America hosted a one-day workshop to review the state of knowledge of flying after diving and to discuss the need for new flying after diving guidelines for recreational diving. The workshop was attended by 40 people, representatives of the recreational diving industry, government agencies and Divers Alert Network. The workshop was chaired by Dr Paul Sheffield, organiser and leader of the 1991 UHMS meeting. The workshop findings and new recommendations have been reported in the latest issue of Alert Diver³ and are published here with kind permission of Divers Alert Network SEAP.

Current flying after diving recommendations:

The recommendations represent the consensus reached by the attendees and are based on reviewing earlier published work and the results of recent studies concerning the risk of decompression sickness (DCS) in flying after diving. The guidelines apply to air dives followed by flights at cabin altitudes of 610m to 2,438m (2,000 to 8,000 feet) for divers who do not have any symptoms of decompression illness (DCI) before the flight.

Recommendations from the 2002 Flying After Diving Workshop:

Dives within the 'No-Decompression Limits':

- A single No-Decompression Dive: A minimum preflight surface interval of 12 hours is suggested.
- Multiple dives per day or multiple days of diving: A minimum preflight surface interval of 18 hours is suggested.

Dives requiring decompression stops:

There is little experimental or published evidence on which to base a recommendation for decompression dives. A preflight surface interval substantially longer than 18 hours appears prudent.

This educational article is written with the intention of making balanced information available to all individuals, particularly those involved in diver training or diver safety. You are free to download this information and print copies for wider distribution. If sections of the articles are used in other publications, they should be fully referenced with acknowledgement being given to the NZUA and the author(s) – www.nzunderwater.org.nz

These new recommendations have come about largely through the work of Divers Alert Network. The workshop reviewed data from the DAN dive injury reports, DAN 'Project Dive Exploration' and from a comprehensive DAN chamber simulated diving study. A summary of this information was presented by Dr Richard Vann (PhD) at DEMA in 2002⁴. Some of the key points have been reprinted here with kind permission of Divers Alert Network.

DAN dive injury reports (since 1987):

- From 1998-2000, 278 of injured divers were involved in flying after diving.
- Of these, over half had symptoms before they flew!
- Clearly there is need for further diver education. With any unusual symptoms after diving, phone the DAN Diver Emergency Service for advice before flying.
- Flying after diving affects severity of DCS. The incidence of residual symptoms, after recompression treatment, was greater for divers that flew than divers that did not fly.
- The take-home message would appear to be, avoid flying with symptoms and wait long enough after diving before flying to avoid getting symptoms

DAN Project dive exploration (since 1998):

- DAN has data for 382 flying after diving injury cases and for 245 injury-free controls.
- 53% of the injured cases waited less than 24 hrs before flying, while 76% of the controls waited more than 24 hrs.
- With the help of statistics, we can show that the relative risk increases as the pre-flight surface interval (PFSI) decreases. The risk increases gradually from 24 to 12 hrs and steeply at less than 12 hrs PFSI.
- Relative risk increases as the maximum dive depth on the last day of diving increases. The deeper the dive on the last day, the higher the risk. If a PFSI of 24 hrs with a max dive depth of 60 fsw (approx 20m) on the last day was defined with a relative risk of one, then a PFSI of 12 hrs after maximum depth of 130 fsw (approx 40m) on the last day has a relative risk 7 times greater.
- Remember, there are no guarantees. We know from the DAN injury reports (and the NZUA Reports), some divers do still get 'bent' after a PFSI of longer than 24 hrs.

The flying after dry (chamber) diving study (1993-1999):

- The basic experiment was a dive (or dives) followed a 4 hr simulated flight to 8,000 feet after a predetermined surface interval.
- There were a total of 802 subject exposures with 40 DCS incidents of which 21 were Moderate, 18 were Mild, and 1 was Serious.
- There were 334 exposures of the four single dive profiles. No DCS observed for single dives less than 60 min at pre flight surface intervals of 11 hours or more.
- Conclusion for a single dive: A 12 hour PFSI seemed acceptable whilst 24 hours seemed quite conservative.
- For repetitive dives, bends occurred at surface intervals of 13 to 16 hrs. No DCS occurred for 52 repetitive dive exposures at 17 hr preflight surface interval.
- Conclusion for repetitive diving: The "greater than 12 hr" rule appears clearly inadequate for repetitive diving and 24 hrs remains conservative.
- Remember, results apply to the dive profiles tested with dry, resting divers. There is no guarantee that the requirements might not be different for open water, multi-day, repetitive recreational diving.

The revised guidelines of 2002 have a better empirical basis than the 1991 guidelines and should be safer. However, there are no guarantees and there will always be a small number of people who fall outside of the 'average' and prudent advice would seem to leave your PFSI

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as long as you can, especially for multiple dives on multiple days, or if dive profiles have been provocative.

Flying after treatment in a recompression chamber:

It is also worth noting here that if a diver has symptoms of decompression illness and has not received appropriate recompression treatment, flying can be risky even several weeks after the dive⁽²⁾. Once recompression treatment has been completed, a diver will be advised to wait several days or even weeks before flying to reduce the risk of symptoms returning during the flight.

Diver Alert Network (DAN) is an international dive safety organisation, working for all divers through education, research and dive incident reporting. In New Zealand, these goals are shared with the New Zealand Underwater Association (NZUA) and the two organisations work closely together to promote safe and enjoyable diving in our waters. In New Zealand calls to the DAN Divers Emergency Service Number 0800 4 DES 111 are funded by DAN and the line is supported and administered by NZUA. Lynn Taylor is a coordinator for DAN in New Zealand and the Dive Incident & Recorder for NZUA.

References:

1. Viva Aqua – March 2003, p5. (www.nzunderwater.org.nz/e-news)
2. John Lippmann & Stan Bugg. 2002. Diving first aid manual DAN SEAP membership edition.
3. Alert Diver SEAP Edition, October-December 2002.
4. Richard Vann PhD. DAN Presentation: Flying after diving: History, Research and Guidelines. DEMA 2002 Las Vegas.