WSF Freediver
- Rescue

World Series Freediving™

RAID™

WSF Freediver - Rescue

THE 4 FREEDIVING ELEMENTS

1. Conserving Oxygen O_2
2. Equalisation EQ
3. Flexibility FLX
4. Safety SFE

The 5th Element that is key to success is you, the freediver!

RESCUE SFE

Blackout, Shallow Water Blackout, Hypoxic Fit

Objectives:

1. List 3 causes
2. List 3 ways to avoid
3. List the 3 step management procedure

Value: Developing the proper knowledge and having the practical skills to recognise and deal with these situations in a safe manner is paramount to successful freediving.

WSF Pro Tip: The human body has a limited supply of oxygen, most of which is carried in our oxygenated arterial blood. When we freedive, the blood is shifted to the important core areas – the heart, lungs and brain – whereas the extremities are left largely void of blood supply for the duration of the freedive. This is the effect of the DR.

If we push our freediving too close to or past the limit of our oxygen supplies (Hypoxia), it is possible for a freediver to experience one of the three low oxygen-related situations. Signs of hypoxia become obvious when the arterial oxygen tension drops below the critical threshold.

The three low oxygen-related situations are:

1. Hypoxic Fit: Losing control of motor skill function but still maintaining consciousness. Indicates you are very close to the limit of oxygen supply.

2. Black out (BO): Unconsciousness. Indicates the oxygen supply to remain conscious has been exhausted. In relation to static breath holds, dynamic swimming or black out that occurs unrelated to depth.
3. Shallow water blackout (SWB) – Unconsciousness on ascent from depth. As the freediver ascends, the partial pressure of oxygen within the body decreases proportionally (Dalton's law). If the freediver has exceeded the limit, the partial pressure of oxygen can become too low to sustain brain activity and an SWB can occur.

According to US Navy data, the human brain is at perfect operation within the 0.21 PpO2 range. The air we breathe at sea level is 21% Oxygen and 79% Nitrogen, so with 1 atmosphere of ambient pressure, this equates to a PpO2 of 0.21.

Hypoxia Threshold (Low $Pp0_2$)		
PpO_2	0.21	Normal PpO_2
PpO_2	0.16	Hypoxic Fit
PpO_2	0.12	Blackout likely
PpO_2	0.10	Minimum to sustain consciousness

Keep in mind that the above is in relation to breath-hold freediving which means circulation is still active. In the past, people have made the mistake of comparing a breath-hold O2 level drop to a drowning victim who has no heart beat or DR. When freediving, there is still oxygen within the system when a possible O2 level drop occurs.

Why does it happen?

The simple answer is that we all have a limit. Staying within this limit is one of the skills of freediving successfully. If we push too far, too deep or for too long we can exceed our limit and have possible Hypoxic Fit/BO/SWB. The human body has an amazing protective feature when we are freediving – if our O2 limit is reached and the O2 level drops into the 0.10 zone, the brain switches off to preserve the remaining oxygen well before it is completely exhausted.

Other physiological manifestations happen at this point to: the throat/larynx will spasm and create a seal so as to not let water enter the lungs. In the past, this has been explained as dry drowning. The laryngo spasm will only last a short while and allows a window of opportunity to rescue a freediver from the water, hence why it is so important to freedive with a buddy!

WSF Pro Tip: Most cases of O2 level drop in freediving are caused by freedivers going too deep, too far for too long, too quickly in their career. Take a more relaxed progression to freediving and you will find far more success and safety.

Signs of BO/Hypoxic Fit/SWB – At depth or on surface

- Exhaling air – as the freediver loses motor control, they lose the ability to hold the air in their lungs and, as such, air can escape the mouth in the rhythm of the contractions from the urge to breathe.
- Tremors - the hands, arms, legs, fingers, head, eyes can display shakes and tremors as a sign of O2 level drop.
- Loss of consciousness – a freediver may just stop fining or moving and slump. This can be suddenly or gradual as the O2 level drop progresses.
- Motionless – a freediver may seem to freeze and be unable to speak or move for a short period of time, then suddenly reanimate and display jerking movements of the head or limbs.
- Blue or purple coloration of the lips, face, ears or skin, this is due to the tissues near the skin surface having low oxygenation.

WSF Pro Tip: Keeping an eye on your buddy for any of these signs is important.

How to avoid: The good news is that BO, Hypoxic Fit and SWB are rare and easy to avoid. By simply taking a relaxed progression to time, depth or distance in your freediving, you can successfully freedive without ever experiencing an O2 level drop.

That is, do not progress your freediving until your past efforts feel easy. If you are very comfortable freediving to 15m, then it is a good time to progress, but only a few metres at a time, to say 17m. If a time, distance or depth feels difficult, it is unwise to progress further, otherwise you are at greater risk of BO/SWB/Hypoxic Fit. Have fun with your freediving and keep it drama free. Freediving becomes easier the more we do it and your progression will be far more successful by avoiding BO/Hypoxic Fit/SWB.

Practical steps to avoiding BO/Hypoxic Fit/SWB:

1. Do not push your limits – only progress when you feel very comfortable at a certain time, distance and depth, and even then only progress conservatively.
2. Wear proper freediving equipment that fits correctly – a form fitting suit, low volume mask, long bladed fins. By conserving oxygen and being relaxed and comfortable you will use less O2
3. Progress conservatively – make sure your previous time, distance or depth was an easy success before you go further. If your previous dive was difficult, then trying to push further is a fast way to failure.
4. Avoid over breathing and hyperventilating. Taking too many large breaths will turn your blood Ph alkaline (the bhor effect) in this state the bond between Haemaglobin and oxygen becomes too strong and the oxygen will not reach the tissues where it is needed, this can cause 02 level drop.

WSF Pro Tip: If you find before a freediving session that you do not feel great, perfect or in good condition for a freediving performance, you will find that you may use more oxygen than you normally would. There could be many reasons for not feeling entirely well, including being cold, tired or sick. Don't hesitate to abort your session or choose to only dive to provide safety for others– wait until next time to challenge your time, distance or depth. You can still have fun providing safety and support for your team and enjoy the ocean and the freediving session.

HOW TO MANAGE A BO/SWB/HYPOXIC FIT: SFE

Providing safety for your freediving buddy is a simple as being there and watching out for them. In static you can be right beside them, during dynamic you can swim with them or watch from the pool edge while walking along side and being ready to act. In depth we use the one down one up approach buddy system and provide safety on the ascent and on the surface.

For All BO/SWB/Hypoxic Fit scenarios we use the following protocol:

RESCUE - Bring the freediver to the surface/keep them on the surface (to keep the airways out of the water).

RESPONSE - Remove mask/or facial equipment, blow air across the facial area, tap the cheeks, instruct them to breathe.

REVIVE - If the response phase does not achieve responsiveness then use rescue breaths to engage a response, deliver O2, open the laryngo spasm to promote breathing response.

WSF Pro Tip: If a freediver experiences an Hypoxic Fit, you can support them until they find their composure, but be ready to initiate Rescue Response Revive as Hypoxic Fit is commonly followed by BO/SWB.

LUNG SQUEEZE

Objectives:

1. List 3 ways to avoid lung squeeze
2. State the most common cause of Lung Squeeze in freedivers

Value: By understanding the causes and how to avoid lung squeeze, you will experience a safer and more enjoyable progression in freediving.

When we look at Boyle's Law and the freediver's chest, which consists largely of air, it is easy to see that as depth increases, so to does the pressure and compression on the freediver's lungs and chest. During descent, the freediver's lung volume will compress in proportion to the depth achieved; then on ascent, they will expand back to the starting volume.

As you gain more skill and experience, you will need to be more flexible and properly adapted to depth and the pressures exerted by Boyle's Law. Eventually, a freediver will be experiencing depths where the lungs will reach residual volume. We must be well adapted to depth and possess a strong DR/blood shift and good flexibility to avoid any lung squeeze at this point.

The DR is initiated when we enter the water. As we have learned, it is vital to have a strong DR for freediving success. In relation to lung squeeze, we rely on the blood shift which is responsible for protecting the lungs at depth. When we dive to depth, the DR shifts blood to the blood vessels and capillaries that surround the lungs and alveoli.

Here, diffusion takes place and this extra volume swells the vessels which compensates for the reducing air volumes, creating a liquid, incompressible barrier against pressure injury (lung squeeze).

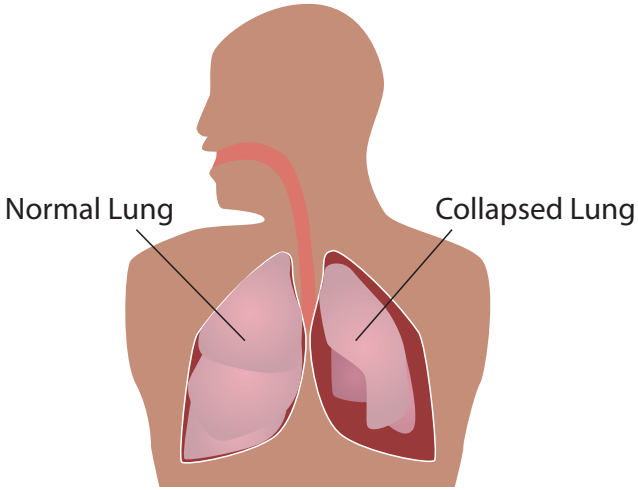
The leading cause of lung squeeze/barotraumas in freediving is lack of patience – rushing to great depths without proper adaptation leads to the damage of airways as a result of negative pressure. We must take time and be conservative when progressing.

Causes of lung squeeze:

- Rushing to deeper depths (not taking time to adapt properly)
- Progressing too deep too quickly (making large depth progression more than 2m at a time)
- Packing the lungs (over expanding the lungs unnaturally before descending thus reducing the DR)
- Incorrect equalising (pushing hard to equalise/valsalva or reverse packing which requires us to use muscles that should be otherwise relaxed and passive)
- Large contractions (urge to breathe as a freediver, may be progressing too quickly/out of their comfort zone)
- Stretching out at depth (lifting the head quickly or stretching the arms out when at deepest point of the dive)

What happens: Many things can happen when we talk of someone who is experiencing lung squeeze. A freediver who has gone too deep too quickly may experience:

- Tissue damage to the alveoli
- Tissue damage to the trachea and bronchi
- Muscle damage in the thoracic area
- Collapsed lungs

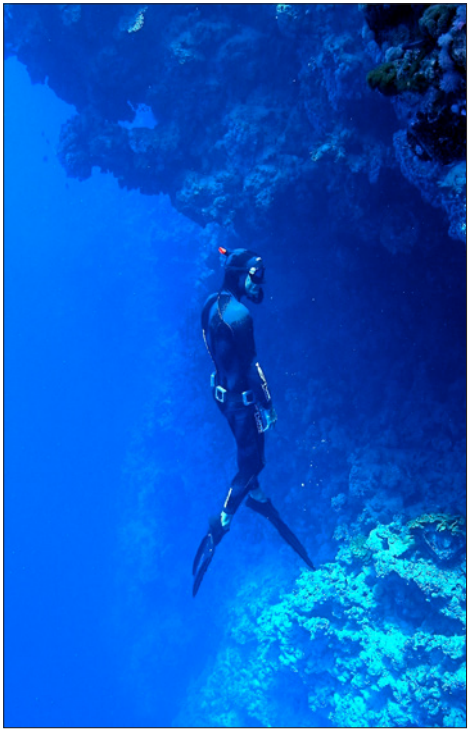


These injuries can be serious, so it is of utmost importance to avoid lung squeeze.

Tissue damage can cause bleeding whereby blood will fill the lungs and stem proper diffusion of oxygen. This can make the victim experience lethargy and light headedness, dizziness, coughing blood from the lungs/throat.

Adapting to depth: Avoiding lung squeeze practically

What is adaptation? Regular freediving at a particular depth will promote adaptation, just like a mountaineer who spends time at altitude will acclimatise to their environment.



The deep freediver needs to spend more time at these depths to become properly adapted before progressing further. Progressing too fast in depth can cause lung squeeze (a serious injury). As you spend more time and complete more dives to a certain depth, your body will adapt and become far more flexible to the pressures; the capillaries around the lungs will become adapted to the swelling from the blood shift; and the lungs will become adapted to the compression effect and negative pressures exerted by these depths.

All these factors are what we call adaptation, or physiological changes that happen to a freediver by spending time at depths. Key points to remember about adaptation to depth:

- Be very comfortable with an achieved depth before progressing any further (many dives to the same depth will promote good adaptation)
- Progress conservatively (only 2m per dive)

This approach will build mental confidence which is a very powerful feeling and leads to success and greater relaxation.

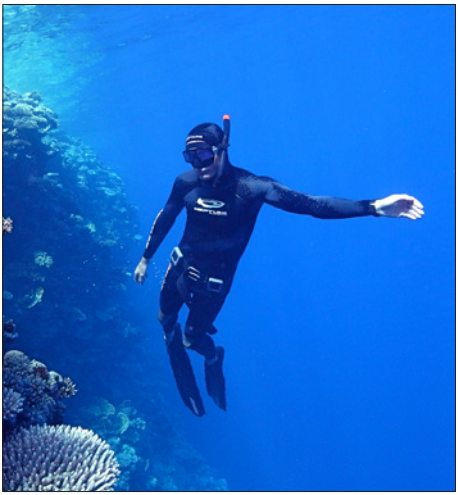
The best training for freediving is freediving – the more dives you complete successfully to a certain depth, the more adapted the body will become. The human body will adapt to circumstance and compensate by sending blood and oxygen stores to where they are needed (in the case of freediving, to the heart, lungs and brain). It is very important to take enough time to adapt properly before progressing to new depths.

Avoid lung squeeze by:

- Keeping flexible by stretching the thoracic area
- Not freediving when cold or stressed
- Freediving regularly and taking time to adapt properly to depth
- Not stretching out at depth
- Not forcing EQ

WSF Pro Tip: You must be comfortable and confident with a certain depth before progressing deeper. For instance, if 20m was successfully completed and felt easy in the past many times, then you can progress. If 30m was successfully completed easily many times, the same concept applies, you may progress, and so on. It is essential that previous dives are completed easily and without drama before progressing further. If you have failed on EQ, or completed a stressed dive with a fast dive time, then it is not recommended to progress further (complete a shallower or same depth dive many more times until it is easy and perfected). This is the main cause of lung squeeze (rushing into the depths). Take time to adapt properly.

When progressing to deeper depths than were previously reached with ease, we must remain conservative. Do not progress any more than 2m at a time. For instance, if you have easily dived 20m multiple times, the next session you can progress to 22m. If 22m becomes very easy then it is reasonable to progress to 24m, and so on. By remaining within our freediving philosophy of relaxation and fun, we can progress safely and make far more successful freedives, all the while avoiding maladies, such as lung squeeze.



When at the deepest point of your dive, try not to make any large or aggressive movements. Keep in mind that the chest will be compressed and so stretching out or moving suddenly can cause problems for muscles that may not be flexible enough – remain relaxed and in a streamlined profile when freediving.

Do not force EQ. If you are having troubles with EQ then abort the dive and return to the surface. Forcing EQ can cause the diaphragm to push up on your already compressed lungs and cause squeeze.

It is normal to experience the urge to breathe or contractions on descent. This can manifest due to the reducing lung volume and stretch receptors within the chest that cause contractions. The rising CO2 can also cause contractions. If the contractions are too large, it may be a sign you need longer to adapt to depth (out of your comfort zone), so take your freediving back a few metres until comfortable and confident.

Do not go too deep too fast in your freediving career. Lung squeeze is serious and life threatening. The good news is that it is very easy to avoid with the above mindset and simple, logical practices.

What to do: If someone has a suspected lung squeeze, they must be removed from the water and, if possible, they should breathe 100% medical oxygen on route to an emergency/specialist.

WSF Pro Tip: Do not continue to freedive with lung squeeze. It is advised to take advice from your doctor on when it is safe to continue freediving if you experience a lung squeeze.

FREEDIVING AND SCUBA DIVING SFE

Objectives:

1. State 2 safety protocols we must keep in mind regarding scuba diving and freediving together.
2. State how many hours we must wait after a scuba dive/ multi scuba dive days/technical diving, before partaking in freediving.

Just like freediving is an adventure, scuba diving is a great underwater activity. In fact, many scuba divers are also avid freedivers and many freedivers enjoy scuba and technical diving!

The 2 sports have similarities in the realm of underwater discovery, but are very different. The scuba diver breathes air at depth, whereas the freediver uses breath-hold. Breathing gas at depth dissolves far more nitrogen into the tissues of the scuba diver, hence they must keep within non decompression limits and surface in a very controlled manner with safety stops. The freediver, on the other hand, is free to move around and up and down in the water column without problem.

If we partake in scuba diving, we will have a residual nitrogen load within our tissues that will need to be off-gassed by surface interval. We cannot freedive during this time as, with this excess nitrogen in our bodies, the faster rate of ascent displayed by freedivers may cause problems with DCS. We must therefore follow the proceeding protocols when we mix scuba and freediving:

- Wait a minimum of 12 hours after a normal recreational limit scuba dive before we do any freediving.
- Wait minimum of 24 hours after a double scuba dive or technical scuba dive before we do any freediving.

WSF Pro Tip: In any multi scuba diving day, there should be at least 24 hours surface time before we freedive.

Expansion Injury

As we have learned previously about Boyle's Law, we know that compressed air at a certain depth will expand on ascent. We must keep this in mind when we freedive around other scuba divers. Never accept air from a scuba diver when underwater as this poses the following risks:

- The air will expand in the lungs on ascent and can cause an arterial gas embolism (AGE) and DCS (you would have to exhale on the ascent the same as scuba diving). This can be fatal if not adhered to.
- Scuba divers sometimes carry many different gasses for decompression and deeper trimix dives. Some can be dangerous or fatal to breathe at a certain depth, so never accept air as you are not sure what is contained in the cylinder.
- Breathing compressed air at depth puts you at greater risk of DCS as when you surface you will have more dissolved nitrogen in your body than if you were on a single breath.

Only accept air from a scuba diver if you are in the rare event of an emergency, such as if you are stuck underwater or trapped.

WSF Pro Tip: A simple rule is that if you start to breathe from scuba while freediving, you become a scuba diver and, as such, must make a normal, controlled scuba ascent with the scuba diver.

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