

Management of oxygen therapy in the dental practice

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Key points

Highlights Resuscitation Council (UK) advice that oxygen should be immediately available in the dental practice.

Describes the incorrect use of emergency oxygen, which has been frequently reported.

Explains why the dental team must be competent at administering oxygen in an emergency situation.

Abstract

Dental practices should have immediate access to oxygen, oxygen tubing and non-rebreathe oxygen masks in the event of an emergency situation. Although oxygen can save lives, if it isn't administered and managed appropriately, there is a potential for serious harm and even death. Dental professionals must, therefore, ensure that they and their team understand the principles of oxygen therapy. The aim of this article is to provide an overview of the management of oxygen therapy in the dental practice.

Introduction

The Resuscitation Council (UK) advises that dental practices should have immediate access to oxygen, oxygen tubing and non-rebreathe oxygen masks in the event of needing to administer high-flow oxygen in an emergency situation.¹ Although oxygen can save lives by preventing severe hypoxaemia, if it isn't administered and managed appropriately, there is a potential for serious harm and even death.² In addition, a recent patient safety alert has highlighted numerous cases where oxygen cylinders have been incorrectly used (operator error).³ Dental professionals must ensure that they and their team understand the principles of oxygen therapy, particularly how to use oxygen cylinders. The aim of this article, therefore, is to provide an overview of the management of oxygen therapy in the dental practice.

Patient safety alert: use of oxygen cylinders

A patient safety alert, 'Risk of death and severe harm from failure to obtain and continue flow

from oxygen cylinders,³ has highlighted that in a recent three-year period, over 400 incidents involving incorrect operation of portable oxygen cylinder controls were reported to the National Reporting and Learning System (NRLS), leading to serious harm and even death in some patients.

Most of the incidents reported related to staff believing that the oxygen cylinders were faulty or empty, but following local investigations operator error was found to be the problem, usually not turning the valve on.³ Also, the design of some oxygen cylinders seemed to cause confusion, particularly relating to turning on the integral valve.

Integral valves

Oxygen cylinders (Fig. 1) with integral valves (Fig. 2) are now in common use and usually require several steps (for instance, removing a plastic cap, turning a valve and adjusting a dial) before oxygen flow starts. When the oxygen cylinder is not in use, the integral valve needs to be in the switched-off position to reduce the risk of fire.³ Unfortunately, an unintended consequence of these changes is that staff may believe oxygen is flowing when it is not, and/or may be unable to turn the oxygen flow on in an emergency.³

Patient safety alert: action points

Following the publication of the patient safety alert, there are four key recommendations that should have already been actioned in dental practices:

1. Identify if oxygen cylinders are used in your organisation, even if only in emergencies
2. Bring this alert to the attention of all those with a leadership role in ensuring clinical staff understand how to operate oxygen cylinders safely
3. Consider if immediate local action is needed and ensure that an action plan is underway to reduce the risk of incorrect use of oxygen cylinders
4. Communicate the key messages in this alert and your local action plan to all relevant medical, nursing, therapy, pharmacy and support staff.³

Patient safety alert: follow-up

Since the release of the patient safety alert:

- Oxygen cylinder manufacturer BOC will be printing a message on the tamper evident seal, advising users that the plastic pull tag must be pulled and the cap removed before the cylinder is used
- BOC are also considering the possibility of putting a message on the plastic cover that protects the fir tree outlet that oxygen tubing is connected to. This message will provide basic instructions to connect the equipment to either the fir tree or Schrader outlet: open the cylinder valve using the black hand wheel; and select a flow, with the top flow selector, to administer the gas to the patient.⁴

BOC also provide clear instructions on how to use their portable oxygen CD size cylinder

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with an integral valve, which can be printed out, laminated and kept close to the oxygen cylinder for ease of reference.⁵ This is available from mark.hughes@boc.com.

Evidence of harm associated with oxygen therapy

The National Patient Safety Agency (NPSA) has received numerous reports of serious incidents relating to inappropriate administration and management of oxygen; of these incidents, poor oxygen management appears to have caused and/or contributed to a number of deaths.² Common themes identified from the review of these incidents, local investigations and other sources are:

- Prescribing: failure to or wrongly prescribed
- Monitoring: patients not monitored, abnormal oxygen saturation levels not acted upon
- Administration: confusion of oxygen with medical compressed air, incorrect flow rates, inadvertent disconnection of supply
- Equipment: empty cylinders, faulty and missing equipment.²

Care and handling of oxygen cylinders

The MHRA's guidance⁶ on the care and handling of oxygen cylinders and their regulators recommends that dental practitioners should:

- Be fully trained in the use of oxygen cylinders
- Be aware of all the related risks such as fire and manual handling
- Carry out full checks on oxygen cylinders and their regulators before each use, ensuring that they contain enough oxygen for the required therapy
- Check the label on the oxygen cylinder, ensuring it is not out-of-date
- Ensure their hands are clean before handling an oxygen cylinder; there is a risk of combustion from oils and grease. It is also important to ensure their hands are adequately dried after the use of alcohol gel
- Ensure that the oxygen cylinder outlet and oxygen regulator inlet are clean before attaching a regulator
- Always open the cylinder slowly and check for leaks. Close cylinder valves when not in use
- Handle oxygen cylinders with care. If the cylinder is dropped or knocked in use it must



Fig. 1 Portable oxygen cylinder

- be checked before further use; cylinders with integral valves should be returned to the supplier; separate regulators should be sent to the service department for inspection
- Ensure that oxygen cylinders are stored in a secure area that is well ventilated, clean and dry, and must be free from any sources of ignition such as patients/staff smoking or machinery
- Report defective oxygen cylinders to the Defective Medicines Reporting Centre (DMRC).

Oxygen therapy equipment

The Resuscitation Council (UK)¹ recommends that, as a minimum, each dental practice should have:

- An oxygen face mask with oxygen reservoir and tubing
- A portable oxygen cylinder of sufficient size to enable the delivery of adequate flow rates, for example, 15 litres per minute, until the arrival of an ambulance or the patient fully recovers. A full 'D' size cylinder contains 340 litres of oxygen and will allow a flow rate of ten litres per minute for up to 30 minutes. It may be necessary to have two such cylinders in the dental practice to ensure the supply of oxygen does not run out during a medical emergency
- An oxygen cylinder key, if appropriate. Some oxygen cylinders require a special key to unlock the cylinder; it is most important that the key is kept with the cylinder

- Ideally, the patient's oxygen saturation levels should be monitored before, during and after oxygen therapy. If a pulse oximeter is available, it should be used. However, usually only dental practices that administer sedation will have a pulse oximeter.

Oxygen face mask with oxygen reservoir

An oxygen face mask with oxygen reservoir, sometimes called an oxygen non-rebreathe mask (Fig. 3), has a one-way valve which diverts the oxygen flow into the reservoir bag during expiration; the contents of the reservoir bag together with the high-flow oxygen (15 litres per minute), results in minimal entrainment of air and an inspired oxygen concentration of approximately 90%.¹ The valve also prevents the patient's exhaled gases from entering the reservoir bag. The use of the oxygen reservoir bag helps to increase the inspired oxygen concentration by preventing oxygen loss during inspiration. To ensure the mask is functioning correctly and is effectively used, it is important to follow the manufacturer's recommendations for simple basic checks before use.⁷

Portable oxygen cylinder

Portable oxygen cylinders are black with white shoulders. There are many different types of portable cylinders available; a commonly used one is featured in Figure 1. This cylinder has:

- A regulator integrated with the cylinder valve
- A gauge that shows 'live' contents at all times, even when the cylinder is turned off
- Simple on-off handwheel (no tools needed)
- Click-stop flow control knob, showing flow in litres per minute, ranging from 1–15 litres/minute
- Sufficient capacity to last approximately 30 minutes at highest flow rate of 15 litres/minute.⁵

Always follow the manufacturer's recommendations when using an oxygen cylinder. Before using the oxygen cylinder:

- If necessary, remove the protective cap
- Attach the oxygen tubing and mask to the fir tree outlet (the oxygen outlet) of the cylinder
- Ensure the flow control knob on the top of the cylinder is set at '0'
- Open the valve slowly by turning the grey or black handwheel anti-clockwise until it stops



Fig. 2 Use of oxygen cylinder: remember to switch on integral valve

- Turn the flow control knob clockwise to select the required flow rate. At each full 'click' a different flow rate setting will be revealed in the 'window' of the knob. The correct flow rate setting must be fully visible in the window
- Select flow rate as per training received
- Check for a flow of gas through the mask before use.⁵
- Turn flow control knob to '0'
- Check the cylinder contents gauge to ensure adequate supply for next administration.⁵

Routine daily checking of oxygen cylinders

It is important to follow manufacturer's guidelines when checking oxygen cylinders. BOC advise the following for routine checking of its oxygen cylinders:

- After using the oxygen cylinder:
 - Turn off cylinder using the grey or black handwheel by turning it clockwise
 - Remove tubing and mask from the fir tree outlet and allow residual oxygen in the regulator to vent
- Check the expiry date
- Check that the contents gauge is in the green zone. This indicates that the cylinder is full.
- NB It is not necessary to switch the oxygen on to check the cylinder.⁵

Guidelines on the administration of oxygen

The British Thoracic Society (BTS) has issued detailed guidance on emergency oxygen therapy in adults.⁸ The guidance relating to the use of high-flow oxygen has caused some concern and confusion regarding its safety. It is emphatically clear that in any critically ill patient the initial administration of high-flow oxygen (15 litres per minute) is the correct course of action. When oxygen saturation levels can be accurately measured using a pulse oximeter (usually when the paramedics arrive), the amount of oxygen administered can be titrated accordingly.

Indications for oxygen therapy in the dental practice

Oxygen is prescribed to treat hypoxaemia.² Oxygen therapy is, therefore, aimed at supplementing the inspired oxygen concentration to prevent tissue hypoxia and resultant cellular dysfunction which can occur in the acutely ill patient.⁸

Indications for administration of emergency oxygen in the dental practice include:

- Syncope
- Acute asthma attack
- Anaphylaxis
- During an epileptic fit
- Cardiopulmonary resuscitation.¹

Procedure for administration of oxygen using a non-rebreathe mask

- Assess and treat the patient following the ABCDE approach; call for help from colleagues. It may be necessary to call 999 for an ambulance
- Explain the procedure to the patient
- If available, attach pulse oximetry (usually only dental practices that administer sedation will have a pulse oximeter) to guide oxygen therapy
- Ensure the patient is in an appropriate position for example, if breathless, the patient will usually prefer to be in an upright position. The patient will probably prefer to swing his or her legs around and sit on the side of the chair with his or her feet touching the floor
- Prepare the oxygen cylinder and attach the oxygen tubing
- Select an oxygen flow rate of 15 litres/min



Fig. 3 Oxygen face mask with reservoir bag and tubing

- Occlude the valve between the mask and the oxygen reservoir bag and check that the reservoir bag is filling up. Remove the finger
- Squeeze the oxygen reservoir bag to check the patency of the valve between the mask and the reservoir bag. If the valve is working correctly, it will be possible to empty the reservoir bag; if the reservoir bag doesn't empty, discard it and select another mask
- Again occlude the valve between the mask and the oxygen reservoir bag, allowing the reservoir bag to fill up
- Place the mask with a filled oxygen reservoir bag on the patient's face, ensuring a tight fit
- Reassure the patient
- Closely monitor the patient's vital signs. In particular, assess the patient's response to the oxygen therapy for example, respiratory rate, mechanics of breathing, colour, oxygen saturation levels (if pulse oximetry available), level of consciousness
- Discontinue/reduce the inspired oxygen concentration as appropriate following advice from a suitably qualified dental practitioner
- Await the arrival of the ambulance.

COPD patients

Although oxygen should be administered with extreme caution in patients with COPD,⁸ in critical illness, high-flow oxygen as described above should be administered.¹

Care, handling and storage of oxygen cylinders

BOC Medical⁵ advises that it is important to:

- Keep the oxygen cylinder away from naked flames and sources of heat. Oxygen is a non-flammable gas, but it does strongly support combustion
- Ensure the oxygen cylinders are stored in a safe and secure area where they cannot fall over and cause injury
- Ensure the oxygen cylinder is stored in a well-ventilated area
- Never use excessive force when opening or closing the cylinder using the grey or black handwheel
- Do not paint the cylinders as all labels and markings must remain clearly visible
- Refrain from using oil or grease (or any oil-based products which includes hand creams) in the vicinity of the oxygen cylinder. High velocity oxygen and oil/grease could cause spontaneous combustion.

Defective oxygen cylinders should be reported to the DMRC and defective detachable regulators to the Adverse Incident Centre (AIC), both at the MHRA.

Conclusion

Critically ill patients should receive high-flow oxygen. Dental practitioners should understand when and how to safely and effectively administer oxygen. An overview of the hazards associated with the use and storage of oxygen has been provided together with the procedure for administering it.

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