Rubber dam in clinical practice

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Good practice guidelines recommend the use of rubber dam for all nonsurgical endodontic procedures; there are also safety and medico-legal implications. However, many unfounded reasons have been cited for not using rubber dam. By explaining why it is essential when performing endodontic treatment, and describing the various techniques of placement, the hope is that it will encourage the routine use of rubber dam in everyday clinical practice.

Introduction

Sanford Christie Barnum first advocated the use of rubber dam almost 150 years ago. Even in that era of dentistry, the benefit of isolating a tooth to obtain a dry working field, free of salivary contamination, was appreciated.

The European Society of Endodontology guidelines recommend the routine use of rubber dam for all nonsurgical endodontic procedures. However, despite being considered an essential part of the endodontic curriculum in undergraduate dental schools, the routine use of rubber dam in general dental practice is far from widespread. The main reasons cited for not using rubber dam by dental practitioners include cost, difficulty of use and patient comfort. These misconceptions have led to poor uptake of the technique in general dental practice.

A survey in the United Kingdom found that only 20% of the dentists questioned used rubber dam regularly for endodontic procedures, and that 60% of the respondents never used rubber dam. Surveys carried out in the United States and New Zealand found that 59% and 57% of dental practitioners, respectively, used rubber dam as a matter of routine. Interestingly, a study in Belgium found that only 3.4% of dentists in the country used rubber dam routinely. A recent investigation into the attitudes and use of rubber dam by Irish general dental practitioners reported that it was not used by 39% of respondents when per-
forming root canal treatment on anterior teeth, 32% when treating premolar teeth and 26% when treating molar teeth7. Many respondents (57%) considered rubber dam ‘cumbersome and difficult to apply’. The aims of this article are, firstly, to explain why rubber dam is essential when performing endodontic treatment, and secondly, to describe the various techniques of applying rubber dam.

- Why use rubber dam?

There are several advantages to using rubber dam during endodontic treatment, as outlined below.

- Safety and medico-legal considerations

Rubber dam protects the patient’s oropharynx, preventing the ingestion8,9 or aspiration8,10 of endodontic instruments/materials and associated dental debris. Performing endodontic treatment without using rubber dam risks harming the patient, and is considered legally indefensible11,12 and contrary to recommended guidelines5,13,14.

- Aseptic working environment

The importance of microbes in the pathogenesis of apical periodontitis is well established15,16. The objectives of endodontic treatment are to eliminate microbial infection, and to prevent re-infection of the root canal system. These can only be predictably achieved when endodontic treatment is carried out under rubber dam.

Rubber dam acts like a surgical drape, isolating the operating field from microbial contamination. In an outcome study, 2459 roots were re-examined 2 to 7 years after initial pulpectomy or following completion of root canal treatment17. No rubber dam was used, and the overall success rate was only 53%. Although no direct inference can be made, the lack of controlled asepsis may also explain the poor outcome also reported by others18.

In another outcome study on root canal retreatment, teeth were treated with (51.1%) and without (48.9%) the use of rubber dam19. A total of 612 teeth were retreated including cases with and without evidence of periradicular pathosis. It was reported that the use of rubber dam had a statistically significant influence on the results of the retreatment.

A pulp capping study evaluated the response of healthy human pulps to calcium hydroxide and bonding agent, carried out with and without the use of rubber dam20. Direct pulp capping was performed on 40 caries-free human premolars, which were scheduled for orthodontic extraction. After a period of 30 or 60 days, the teeth were extracted and serial histological sections of the teeth prepared. The study found a more severe inflammatory response in the pulps of teeth capped with the bonding system in the absence of rubber dam. The authors concluded that the only explanation for the poorer results with the bonding agent group, where pulp capping was carried out without rubber dam isolation, was likely to be due to bacterial contamination during the operative procedure.

There is evidence suggesting a relationship between choice of irrigant and rubber dam usage3-5. In a study of British general dental practitioners, 71% of rubber dam users irrigated root canals with sodium hypochlorite compared with only 38% who did not use rubber dam3. A positive relationship between the use of rubber dam, and irrigation with sodium hypochlorite and/or EDTA was also observed in surveys carried out on dentists in the United States and New Zealand4,5.

- Access and visualisation

Rubber dam improves access to the operating field as the soft tissues including the cheeks and tongue are retracted and protected. In addition, visual contrast is enhanced when a dark-coloured rubber dam, for example green or blue, is used21.

- Improved efficiency

Rubber dam facilitates the efficient practice of four-handed dentistry during endodontic treatment. Instead of having to be careful about protecting the patient’s airways, controlling and retracting the soft tissues, both the operator and the dental nurse can concentrate on the endodontic procedure. Treatment is also not interrupted as rubber dam reduces the patient’s need to spit or rinse out by reducing the accumulation of fluids in the mouth.
Reduction of aerosol contamination

The air turbine is an effective atomiser of saliva, blood, crevicular fluid and exhaled products from the alimentary and respiratory tracts. Without rubber dam the aerosol created may result in contamination of the working environment; this has cross-infection implications for both dental team members and patients. The use of rubber dam results in a reduction of 70 to 98.8% in the microbial content of air turbine aerosols produced during operative procedures, thereby reducing the risk of cross-infection22-24.

Patient comfort

Contrary to belief, most patients do not find the use of rubber dam an unpleasant experience. Like anything new, if it is the patient’s first experience of rubber dam, the concept may be daunting. However, rubber dam is well accepted by patients25 and the argument against its use because of patient comfort is an unfounded myth.

How to use rubber dam

The basic parts of the rubber dam kit are described below.

Rubber dam

Rubber dam is available in pre-cut, commonly 150 mm squares (Fig 1). In addition, and less common, rubber dam is also available in a roll that can be cut to size. Scented rubber dam is manufactured by some companies and this variety may be useful when treating children, as they may dislike the smell of rubber.

Rubber dam comes in a variety of thicknesses – light, medium, heavy and extra heavy. Medium thickness rubber dam is more suitable for endodontic treatment; it is thin enough to be stretched easily over the rubber dam clamp and tooth, yet thick enough not to tear easily.

Rubber dam is available in a variety of different colours; the darker colours, for example, green, black and purple, give better colour contrast and therefore may help reduce eye strain. The choice of rubber dam thickness and colour is usually down to personal preference. Rubber dam is usually shiny on one side and matt on the other side; when placed, the matt side should, preferably, face the operator as it reduces glare and eye strain.

The performance and quality of rubber dam is best where the stock is not too old and has been stored in a cool, dry environment, preferably refrigerated. Old stocks of rubber dam that has not been stored properly may lose its elasticity and become more susceptible to tearing.

Rubber dam clamps

The rubber dam is usually anchored to the tooth with a rubber dam clamp. There are over 50 different designs of rubber dam clamps (Fig 2) available, from a variety of different manufacturers. Some are labelled numerically and others alphabetically; there are even colour-coded systems (Hygenic Fiesta, Coltène/Whaledent, Cuyahoga Falls, OH, USA). Each clamp consists of a set of jaws connected by a bow. There are also clamps with asymmetric and serrated jaws to provide better anchorage to the tooth (Fig 3). The selected rubber dam clamp should achieve four-point jaw contact at the cervical region of the tooth.

The clamp that is chosen will be dependent on the tooth to be isolated, the application technique employed and the operator’s preference. Rubber dam
Clamps may be classified as winged or wingless (Fig 4). Winged clamps allow rubber dam to be applied in one step and also result in more tissue retraction. Wingless clamps are used with the two-step technique (see later).

Most rubber dam clamps are made of stainless steel but some are made from plated steel. There are also non-metallic clamps made of plastic (SoftClamp, KerrHawe, Bioggio, Switzerland) on the market. Rubber dam clamps made of plated steel are more susceptible to corrosion; they are affected by, for example, sodium hypochlorite. More importantly, all clamps are at risk of fracture during use. Although rubber dam clamps are very durable when appropriately handled and treated, they do not last forever. Fracture of the rubber dam clamp in the mouth is probably the only serious risk associated with rubber dam usage. The risk of inhaling or swallowing the fractured or dislodged clamp may be minimised if it can be retrieved. A generous length of dental floss or tape may be tied through one of the clamp holes, wound around the bow of the clamp and then passed through and tied to the opposite clamp hole (Fig 5) for this purpose.

Rubber dam clamps can also be classified as retentive or bland (Fig 6). Retentive clamps provide four-point contact on the tooth. They engage the tooth at a point below its greatest convexity. Retentive clamps retract the gingival tissues if the jaws engage at, or beyond, the level of the gingival margin. Bland clamps are made with flatter jaws, which maintain their position with a more passive engagement. Gingival impingement is less likely with bland clamps but these clamps are more susceptible to dislodgement.

**Clamp forceps**

The rubber dam clamp forceps are used to transfer, place, adjust and remove the clamp. Rubber dam clamp forceps come in a variety of designs, and in some cases, may be specific to a particular clamp system. Popular forceps designs include the University of Washington/Stoke, Brewer (Ash, Dentsply, Weybridge, Surrey, UK) (Fig 7) and Ivory (Heraeus Kulzer, South Bend, IN, USA) patterns. With some patterns, if the jaws are too retentive, it is difficult to disengage the forceps from the clamp. The jaws may be modified to make them less retentive to allow for easier clamp disengagement.

**Rubber dam punch**

A punch is used to make the necessary number of holes in the rubber dam, corresponding to the number of teeth to be isolated. In the case of endodontic treatment, usually single tooth isolation is used. There are two main types of rubber dam punches. A single-hole punch (Ash, Dentsply) (Fig 8) will cut a standardised hole of 1.63 or 1.93 mm. Punches with a rotating table (e.g. Ainsworth, Ivory) are for cutting different sized holes. The Ainsworth is a five-hole punch (Fig 9), which will make holes of diameters ranging from 0.5 to 2.5 mm. Rubber dam punches capable of producing multiple sized holes are meant to allow the operator to vary the size of the hole according to the tooth to be isolated or the clamp to be used. Larger holes may be chosen for molar teeth or winged clamps. However, one of the disadvantages is that unless the punch table is properly aligned, the result will not be a cleanly produced hole and the rubber dam will tear.

For single tooth isolation, a hole is punched approximately 2 cm from the centre of the rubber dam, in a position corresponding to the position of the tooth in the quadrant. If several teeth are to be
Fig 3  Rubber dam clamps with serrated, asymmetric jaws: Hygenic 12A (left) and 13A (right).

Fig 4  Winged (Ash A & K) and wingless (Ash PW) rubber dam clamps.

Fig 5  Floss tied onto the rubber dam clamp to aid retrieval in case of fracture or dislodgement.

Fig 6  Bland (left) and retentive (right) rubber dam clamps.

Fig 7  University of Washington/Stoke (left) and Brewer (right) rubber dam clamp forceps.

Fig 8  The Ash single hole rubber dam punch.
isolated, it may be helpful, but not essential, to use a rubber dam stamp (e.g. Hygenic Dental Dam Stamp, Coltène/Whaledent), to facilitate correct positioning of the holes. Irrespective of the type of rubber dam punch used, it is important to ensure that the cutting part of the punch is sufficiently sharp so that clean holes are obtained consistently.

## Rubber dam frame

The final component is the rubber dam frame; this is used to retract the edges of the rubber dam. The rubber dam is pulled over the frame and secured in place by the retaining spikes. Metal (Fig 10) and non-metal rubber dam frames are available. Plastic rubber dam frames (Fig 11), some with rounded retaining spikes, are lighter and more comfortable for the patient. A further advantage of a plastic frame is that some are not radiopaque, so may be left in place when taking radiographs. Foldable rubber dam frames (e.g. Ash, Dentsply) with an articulated joint are also available to facilitate radiography.

## Techniques for rubber dam placement

There are a variety of techniques for rubber dam placement. Irrespective of the technique used, certain preparatory steps must be taken to ensure safe and effective rubber dam placement:

- Flossing the interproximal space between the teeth beforehand makes rubber dam placement easier.

The contact points of the tooth/teeth isolated should also be flossed again following placement of rubber dam to ensure that the entire circumference of the tooth is sealed.

- As mentioned previously, a length of floss may be tied around the clamp as a safety measure, to aid retrieval, in the event the rubber dam clamp is dislodged or fractures.

- The rubber dam clamp should be placed on the tooth to check that the jaws are in contact with the tooth and the clamp is stable. The stability of the clamp may be confirmed by applying gentle pressure with a forefinger to the bow of the clamp to check if the clamp moves.

- A clean hole should be punched in the rubber dam; there should be no irregular edges or tears, which may increase the probability of the rubber dam tearing.

## One-step technique

A winged rubber dam clamp is selected and placed on the tooth to check for suitability; the clamp should be stable with good contact between the jaws and the tooth. The clamp is then removed from the tooth. A correctly positioned hole is punched through the rubber dam, and the bow of the clamp is pushed through the hole, leaving just the wings of the clamp under the rubber dam (Fig 12). The forceps are then used to engage and spread open the jaws of the clamp. The whole assembly is transferred and positioned on the tooth. The clamp is then released from the forceps and the stability of the clamp rechecked.
The rubber dam is then eased off the wings of the clamp with a flat plastic instrument or excavator. A napkin (e.g. Hygenic Ora-Shield Dental Dam Napkins, Coltène/Whaledent), piece of gauze or paper towel/tissue may be placed below the rubber dam to absorb any saliva and improve patient comfort before placing the rubber dam frame. Finally, the frame is used to stabilise and retract the edges of the rubber dam.

A modification of this technique involves the rubber dam, clamp and frame being all applied in one action. This ‘all-in-one’ technique involves attaching the punched rubber dam to the frame, with the hole positioned roughly in the centre. The clamp is then placed through the rubber dam as described above. Having engaged the forceps to the rubber dam clamp, the whole assembly (Fig 13) is positioned on the tooth. The rubber dam is then eased off the wings and, if necessary, the frame can be adjusted to ensure there is not too much tension on the rubber dam. Where appropriate this technique is extremely expedient as it is truly a one-stage technique. However, this technique is not easy to use, particularly when isolating posterior teeth because of reduced access.

Two-step technique

Rubber dam clamp first method

A winged or wingless rubber dam clamp is selected and placed on the tooth to be isolated (Fig 14). The rubber dam is the stretched over the clamp (Fig 15) and dental floss is passed through the interproximal space (Fig 16). The frame is then used to hold the rubber dam.

Rubber dam first method

A modification of the two-step technique is where the rubber dam is applied first and then secured with a clamp. This technique may be useful for isolating anterior teeth where a butterfly-shaped rubber dam clamp or a wedging device, for example, a strand of stabilising cord (Wedjets, Hygenic, Coltène/Whaledent) (Fig 17) is used. When isolating anterior teeth without the use of a clamp, the rubber dam is applied to the teeth to be isolated; each contact point is flossed to ensure that the rubber dam has passed below the contact point. The interproximal contact points may then be
secured with a strip of rubber dam or stabilising cord (Fig 18). Multiple teeth may be isolated with either of the two techniques described above. A hole should be punched for each tooth to be isolated, and these holes should be approximately 6 mm apart and roughly follow the curve of the dental arch to be isolated.

**Difficult to isolate cases**

**Split dam technique**

If a tooth is broken down, there may not be sufficient sound tooth structure to retain a rubber dam clamp. Alternatively, the clamps available may not permit a stable four-point contact around the tooth. In these situations, one or both neighbouring teeth may be used to help anchor the rubber dam. In the split dam technique, a rubber dam clamp is placed on a neighbouring tooth. Two holes approximately 5 mm apart are punched through the rubber dam and linked up by removing the rubber between the holes using scissors or by punching a third hole to connect the first two holes. The rubber dam is stretched over the rubber dam clamp/s and teeth; the rubber dam frame is then placed. When isolating anterior teeth, clamps may not be necessary with the split dam technique (Fig 19).
If there are signs of leakage once the rubber dam is on the tooth, more likely with the split dam method, then caulking material (e.g. Oraseal, Ultradent, South Jordan, UT, USA) (Fig 20) or temporary filling materials (e.g. Cavit, 3M Espe, St. Paul, MN, USA) may be used to improve the seal. Oraseal is made from hectorite clay and is an easy to handle caulking putty, which can be syringed directly around the tooth to seal any deficiencies (Fig 19b). However, an excessive amount should be avoided as the material may contaminate the working field. Alternatively, light-cured materials (e.g. Kool-Dam, Pulpdent, Watertown, MA, USA) are available. Cyanoacrylate adhesive has also been suggested for sealing voids in rubber dam.\textsuperscript{28}

Preparatory treatment of a broken down tooth

Another option, if the tooth is too badly broken down and it is not possible to use rubber dam, is to consider building a provisional restoration or placing a copper or orthodontic band on the tooth first. This is particularly relevant if lack of structural integrity means the tooth does not allow retention of an inter-appointment temporary dressing without compromising the coronal seal.

A provisional restoration may be built using adhesive materials such as composite resin or glass ionomer cement. Alternatively, a customised and trimmed copper or orthodontic band may be cemented on the tooth; this will then allow the effective placement of rubber dam.
Endodontic radiography

Radiographs are needed at various junctures during root canal treatment, for example, working length determination. The presence of rubber dam may hinder the use of beam-aiming devices when taking radiographs using the paralleling technique. There are specially designed devices available on the market that permit the taking of radiographs without having to remove the whole rubber dam assembly. The EndoRay II (Dentsply Rinn, Elgin, IL, USA) (Fig 21), for example, is a film packet holder with a basket to accommodate the bow of the rubber dam clamp and root canal instruments.

The rubber dam should not be removed during treatment but, if necessary, the frame may be removed when taking radiographs. The rubber dam is then gathered to one side of the mouth. It is imperative to prevent the ingress of saliva into the working field by ensuring that the edges of the rubber dam remain outside the mouth during the taking of radiographs. In order to facilitate correct orientation of the rubber dam frame when it is put back, a hole may be punched in a chosen corner of the rubber dam.

In some cases, it may be possible to take peri-operative radiographs without the need to completely remove the rubber dam frame. Sometimes, only a corner needs to be freed from the frame to enable placement of the film packet/sensor. A radiolucent plastic or foldable rubber dam frame may be used if this technique is chosen.

Latex allergy

Allergy to latex in rubber gloves and rubber dam appears to be an increasing problem in dentistry. The prevalence of latex allergy in the general population may be as low as 1%29. However, the prevalence may be higher in certain groups, including atopic individuals and health workers30. Studies have suggested that the prevalence of latex allergy may be as high as 6% in dental staff31 and 9.7% in dental patients32. Therefore, the possibility of allergic or delayed-type sensitivity reactions to latex rubber dam must not be underestimated. Careful identification of patients who are known or suspected to be allergic to latex or natural rubber is imperative. The patient’s medical history should be checked to ensure the use of latex rubber dam is avoided. Non-latex rubber dam, for example Flexi Dam (Roeko, Coltène-Whaledent) (Fig 22), may be of use for allergic or high-risk cases patients such as atopic individuals.
The increased awareness of latex allergy has led to some institutions, like dental schools, phasing out the use of latex-containing products. However, there is still the danger that sensitisation to these alternative materials may occur. This was highlighted in a recent case report, where a delayed Type IV allergic reaction occurred during endodontic treatment, with the use of latex-free gloves and a silicone rubber dam\(^3\).

### Conclusion

The use of rubber dam is mandatory during endodontic treatment. Current guidelines have re-emphasised that rubber dam should be universally employed for all endodontic treatment. Endodontic treatment carried out without the use of rubber dam has implications both from a safety and medico-legal standpoint.

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### References


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