



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

International Journal of Current Research
Vol. 11, Issue, 10, pp.7708-7714, October, 2019

DOI: <https://doi.org/10.24941/ijcr.36879.10.2019>

REVIEW ARTICLE

NEWER ADVANCES IN RUBBER DAM

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ARTICLE INFO

Article History:

Received 14th July, 2019

Received in revised form

09th August, 2019

Accepted 15th September, 2019

Published online 30th October, 2019

Key Words:

Rubber dam, isolation,
Endodontic treatment.

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Citation: Dr. Anandita Sengupta, Dr. Varsha Pandit, Dr. Pooja Gandhe, Dr. Nirmitee Gujrathi, and Dr. Shweta Chaubey. 2019. "Newer Advances in Rubber Dam", *International Journal of Current Research*, 11, (10), 7708-7714.

ABSTRACT

The use of rubber dam is considered as the standard of care by professional organizations. The role of microorganisms in causing root canal infection is well known and the importance of eliminating them from the root canal system for successful root canal treatment. The use of rubber dam provides absolute dryness of the field, better control of cross-infection, prevents soft tissue contact of chemicals, and improves treatment efficiency. However, recently by the introduction of many newer variations, its use in endodontics has been made easy. The purpose of this paper is to review the advances in rubber dam materials and discuss their possibilities to use in endodontics.

INTRODUCTION

The rubber dam has been used in dental care for decades and its use is well described. It was introduced in dental practice by Dr Sanford Barnum in 1864 (Cardoso *et al.*, 2018). It is still the most ideal means of isolation till date (European Society of Endodontology, 2006). The use of a dental rubber dam in humans provides better control of cross-infection and improves treatment efficiency. It provides an aseptic field isolating the tooth from salivary contamination, improves access and visibility to the operating field by retraction of soft tissues. Also, protects from possible aspiration or swallowing of instruments, drugs, irrigating solutions, and tooth/material debris (Schindler, 2008 and Glickman and Vogt, 2011). Conventional root canal treatment aims in proper cleaning, shaping and obturating the root canal system. Main challenges faced during endodontic treatment are moisture control from the operating field and elimination of bacteria from within the root canal system. This is achieved by repetitive irrigation and enlargement of the main canals (Journal of Taibah University Medical Sciences, 2016). In endodontic treatment, isolation plays a very important role as it helps in control of cross infection, protects the patient by preventing inhalation or aspiration of instruments or materials used during dental

procedures protecting the operator from legal responsibilities and improving treatment efficiency (Harrel and Molinari, 2004). Amongst all the methods of isolation of teeth, the ideal and the best method of isolation is rubber dam isolation. By professional organizations rubber dam is considered as the standard of care (Maslamani and Mitra, 2018). It is well known that the role of microorganisms in causing root canal infection and the importance of microorganism elimination of the root canal system for successful root canal treatment (Sjogren *et al.*, 1990). Successful treatment depends on effective contamination control measures to eliminate infection and prevent reinfection of the root canal system. This can be more predictably achieved by isolating the operating field, as shown by evidence demonstrating that using a dental dam improves the outcome of endodontic treatment (Cardoso *et al.*, 2018). Rubber dam is a mandatory adjunct and is universally acknowledged particularly during endodontic and aesthetic treatment. Its usage has been advocated and encouraged by many authors to adopt in routine practice including operative dentistry field (Ahmad, 2009).

Advantages of using rubber dam during endodontic procedures (Ballal *et al.*, 2013)

- Enhanced access and visibility to the working area.

- Provides dry and clean operating field.
- Retracts and protects the soft tissues against possible trauma from rotary and hand instruments and endodontic medicaments.
- Protects patients from possible aspiration or swallowing of endodontic instruments, medicaments, irrigating solutions and debris.
- Significantly reduces the microbial content of air turbine aerosols produced during endodontic procedures, thereby reducing the risk of cross-infection.
- Improves the properties of dental materials by preventing the moisture contamination of restorative materials.
- Enhances operating efficiency and increased productivity. Patient management is simplified by avoiding need to rinse the mouth of debris.
- Eliminates need for repeated change of cotton rolls due to flooding of saliva or root canal irrigants.
- Minimizes patient’s conversation during root canal treatment and encourages them to open their mouth.

Contraindication to the use of the rubber dam includes (Ballal et al., 2013)

- Patients with latex allergy
- Asthmatic patients
- Psychological reasons

I. Instruments needed for rubber dam isolation and their newer advances

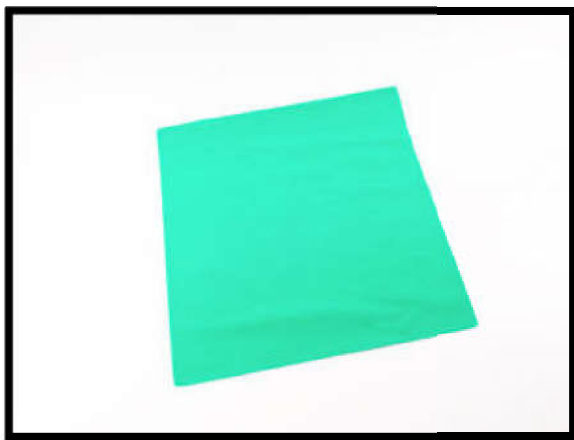


Fig 1. Rubber Dam Sheet

Available sizes	5” x 5” inches 6” x 6” inches, as well as rolls
Colors	light, blue, gray, and green
Thicknesses	special heavy, extra heavy, heavy, medium, and thin

In Endodontics, where one tooth is isolated at a time, the 5” x 5” format is more than sufficient, even for working in the posterior sectors of the mouth. The 6” x 6” format is useful in restorative dentistry, where it is necessary to isolate several teeth at the same time Dark and light colors are available (Journal of Taibah University Medical Sciences, 2016).

New advances in rubber dam sheet

Hygienic dental dam (Fig1.1) is a non-latex rubber dam for patients with latex allergies. It is a powder-free, synthetic dam and comes in just one size i.e. 6 X 6 inches. It has a shelf life of 3 years and has the same tensile strength that of a latex dam.

a. Derma dam (Ultradent Products, Inc, USA)

Derma dam (fig 1.2) is also a nonlatex and powder-free rubber dam which removes the possibility of latex reactions. It has a low content of surface proteins and has an advantage of having low dermatitis potential, reduced allergic reactions and greater tear resistance.

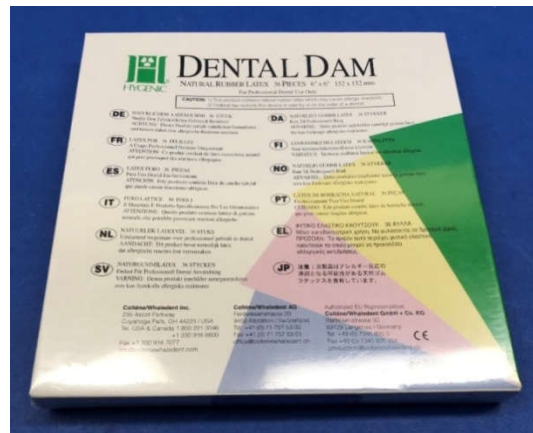


Fig1.1 Hygienic Dental Dam

b. Flexi dam (Coltène/Whaledent)

Flexi dam (Fig 1.3) is an elastic nonlatex dental dam made from an elastic plastomer. It can be elongated more than 1000 % before tearing. It is more tenacious than latex dam and is simple to place. The punched hole should be 1 or 2 sizes smaller than normally used for latex dam and it needs to be stretched before use.



Fig1.2 Derma Dam

1. RUBBER DAM PUNCHES



Fig 2. Rubber Dam Punch

Rubber dam punches (Fig 2) used to make round holes of different diameters (0.7 – 2 mm) on the rubber dam, depending on the tooth to be isolated. It is necessary to check whether the dam opening is exactly round, without irregularities. To determine this, it suffices to punch a hole in a dam sheet and then enlarge this opening by stretching the sheet in different directions. The dam should not tear (Bhuva *et al.*, 2008)

2. RUBBER DAM CLAMPS



Fig 3. Rubber Dam Clamp

The fit of the rubber dam essentially depends on the choice of the appropriate clamp (Fig 3) and its correct positioning. The clamps are classified as winged or wingless. The positioning techniques vary slightly. Sometimes wingless clamps are preferred, as they are less bulky and may be used easily in the posterior sectors in patients with particularly thick cheeks. The most commonly used are:

Front teeth - IVORY # 6, IVORY # 9, IVORY # 90N, IVORY # 212S, IVORY # 15

Premolars - IVORY # 1, IVORY # 2, IVORY # 2A

Molars that are incompletely erupted or already prepared for a full crown- IVORY # 7, IVORY # 14

Asymmetrical molars, in particular the second and third - IVORY # 10, IVORY # 11 IVORY # 12A, IVORY # 13A
Wingless, to be used when the wings obstruct the working field -IVORY # W8AIVORY # 26N

The clamps are modified to improve their grip and allow a more precise fit. A premolar clamp can also be used on a small molar or frontal tooth, or a # 9 clamp on a hemisected root of a lower molar; any such adaptation is permitted, as long as the final result i.e. correct placement of the rubber dam is achieved. The only danger is fracture of the rubber dam clamp once it has been positioned in the mouth. If this occurs, the elasticity of the dam will cause the fragments to be ejected from the patient's mouth. It is therefore prudent to secure the clamp with dental floss and anchor it to the dam frame (Vedavathi *et al.*, 2013).

A. Newer advances in rubber dam clamps

i. Clamp with long guard extension

Clamp with long guard extension (Fig 3.1) has a larger wing which is used for retraction of the tongue. These clamps retract and protect the cheek and tongue along with isolation.

They can be used with gauze or cotton rolls just for the retraction of tongue and cheek (Sauveur, 1997).



Fig 3.1. Clamp with long guard extension

ii. Tiger clamp

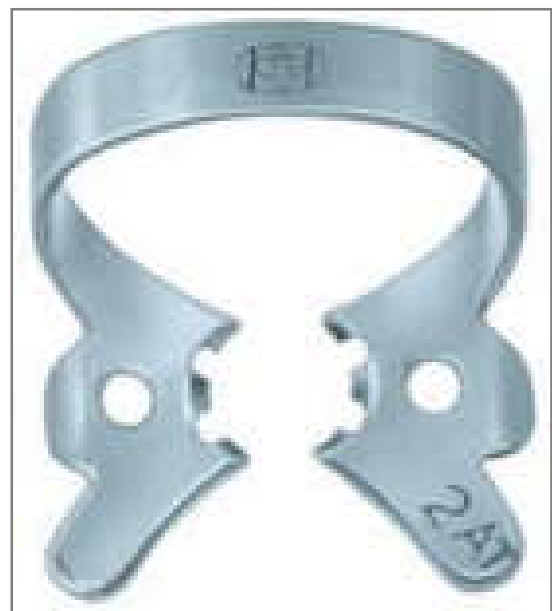


Fig 3.2. Tiger clamp

Tiger clamps (Fig 3.2) are clamps with serrated jaws. These serrations increase the stabilization of the clamp on the partially erupted or broken down teeth.

i. S-G (Silker-Glickman) clamp



Fig 3.3. S-G clamp

S-G clamp (Fig 3.3) is a clamp with anterior extension which allows for retraction of the dam around a severely broken-down tooth, and the clamp itself is placed on a tooth proximal to the one being treated. It is made from durable cast stainless steel, which is autoclavable, corrosion-resistant, flexible and long lasting. It is ideal clamp for molar isolation. Its extended wings allows for rubber dam placement around the teeth with minimal tooth structure.

Super Clamp (Dent Corp Research And Development, NY, USA)



Fig 3.4. Super clamp

Super clamp (Fig 3.4) comes with a pre-cut rubber dam material designed to fit the clamp. It is very simple to use, quick and easy to place. It allows for easy evacuation of oral fluids with a saliva ejector or a high-volume evacuator, and also can be used without the rubber dam to protect only the tongue and soft tissues. The clamp is made out of a thin, flexible stainless steel. It can be sterilized by autoclave, chemiclave or even dry heat. However, it has one disadvantage that, it cannot be used for anterior teeth. It comes in three sizes: L- large clamp for molars, M- medium clamp which can also be used for molars and S- small clamp which can be used for premolars (Scardina, 2009).

Gold colored clamps

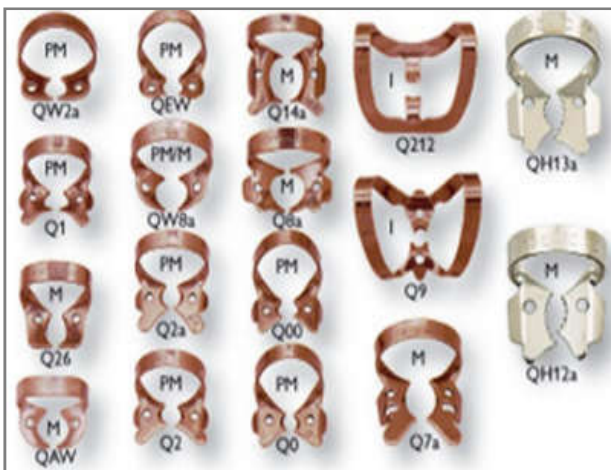


Fig 3.5. Gold colored clamp

Gold colored clamps (Fig 3.5) have diamond grit on their jaw to improve the retention of the clamp.

Rubber dam clamp forceps



Fig 4. Rubber dam clamp Forcep

Rubber dam forcep (Fig 4) is necessary to open the clamp and position it around the tooth. The Ivory forceps are preferable, because they allow the dentist to apply direct pressure toward the gum, which is frequently necessary to position the clamp securely below the bulge of the tooth crown.

Rubber dam frame

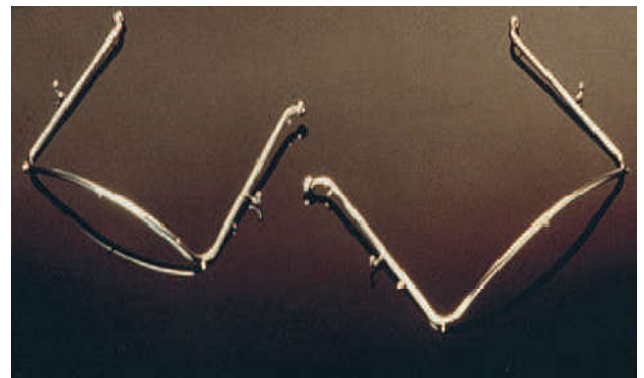


Fig 5. Rubber dam frame

Rubber dam frame (Fig 5) is necessary to maintain tension in the dam so that the lips and cheeks may be retracted well. Some frames, including the Young frame, are made of very thin metal; others, including the Nygaard-Ostby or Starlite frame, are plastic. In comparison to the Young frame, the latter have the advantage of being transparent; on the other hand, they are bulkier. Dam tensors such as those of Woodburg, Cogswell, Mitchell, and Fernald, which are based on the principle of maintaining tension in the dam by the use of clips and elastic bands passing directly over the nape of the neck, are out-dated and have no use in modern Endodontics (Ingle *et al.*, 2002). Furthermore, they have numerous disadvantages: they require more time for positioning; they completely cover the patient's nose and mouth, giving him the unpleasant sensation of suffocation; and they do not cause the least bit of retraction of the lips or cheeks, like the others (Cochran *et al.*, 19879).

Newer advances in rubber dam frames

The older frames have numerous disadvantages such as, requiring more time for positioning, they completely cover the patient's nose and mouth, giving the patient unpleasant

sensation of suffocation and they do not cause retraction of the lips or cheeks. Recently newer frames have been marketed into endodontic practice which has many added advantages.

Articulated frame



Fig 5.1. Articulated Frame

The articulated rubber dam frame (Fig 5.1) (IRED, France) is made of non-irritant plastic material (polysulfone) currently used in the agro alimentary industry and has the following features

- A double hinge situated in the vertical axis of the frame, which allows it to be folded in half in the vertical direction.
- A brace situated at the bottom of the frame allows turning the dam sheet back on itself creating a reservoir into which compresses or an aspiration device may be placed.
- The articulated frame has an advantage in providing access to the buccal half of the cavity.
- This accessibility facilitates proper positioning of the radiographic film, administration of additional local anaesthetic, and evacuation of therapeutic liquids, which may have accidentally entered the buccal cavity.
- In addition to this, it has a reservoir at the bottom of the frame that allows the placement of gauze to compress and an aspiration canula to avoid leakage of fluids such as sodium hypochlorite onto the patient's clothing.

Safe T- frame



Fig 5.2 Safe T- Frame

The Safe-T-frame (Sigma Dental Systems) (Fig 5.2) is composed of two hinged frame members whose snap-shut

locking mechanism securely clamps the rubber dam sheet in place. This concept also makes it possible to retain the traditional U-formed frame geometry and dimensions and offers a secure fit without-stretching the rubber dam sheet. It also has a further advantage of, raised edges of the frame which provide a barrier around the sheet preventing fluids from escaping on to the patient. This contributes to greater patient comfort.

B. Recent alternatives to Rubber Dam

Insti dam (Zirc)



Fig 6.1. Insti dam

Insti dam (Fig 6.1) has an in-built flexible radiolucent nylon frame eliminating the need for a separate one. It is made of translucent natural latex that is very stretchable, tear-resistant and provides easy visibility. There is an off-centre pre-punched hole which customizes fit to any quadrant. More holes can be added if desired. Its compact design is just the right size to fit outside the patient's lips. It has the following advantages.

- Built-in flexible frame which eliminates the use of separate frame.
- Pre-punched hole helps eliminate tearing.
- Radiographs may be taken by bending the frame without removing the dam.
- Minimal pull on clamp.
- Single-use and hence eliminates the need for sterilization.

Handi dam (Aseptico)



Fig 6.2 Handi Dam

Handi dam (Fig 6.2) is a pre-framed rubber dam which eliminates the need for traditional frames.

It is quick and easy to place. It allows easy access to oral cavity during the root canal procedure.

Dry dam



Fig 6.3. Dry Dam

Dry dam (Fig 6.3) is an alternative type of rubber dam which does not require a frame. It consists of a small rubber sheet set in the centre of an absorbent paper with light elastics on either side to pass over the ears. It fits like a face mask with an absorbent lining to give patient comfort and reduced risk of allergic reaction. It is available in medium and thin varieties. It is useful for quickly isolating anterior teeth but it is not useful for isolation of posterior teeth. It has an added disadvantage of not being useful in a bleaching procedure due to the absorbent nature of the paper surrounding it.

i. Framed Flexi Dam (Coltène/Whaledent)



Fig 6.4. Framed Flexi Dam

The Hygienic non-latex flexi dam (Fig 6.4) is also available with an convenient, built-in-frame. The flexible frame is designed with a convenient working size of 100 mm x 105 mm to ensure easy placement without limiting access. The dam has good tear resistance and is latex allergy free and odourless. The smooth surface of the plastic frame helps to maximize patient comfort when positioned against their skin.

ii. Opti Dam (Kerr)

Opti Dam (Fig 9.5) is the first rubber dam with 3-dimensional shape and nipple design. The 3-dimensional shape of Opti Dam and the anatomical frame shape match the contours of the mouth. This allows greater access and improved visibility to the working area. This also allows reduced tension resulting in easier rubber dam application and low risk of clamp displacement. Opti Dam is available in two versions: anterior and posterior.

Opti Dam involves much less preparatory work than for conventional rubber dams. i.e. no marking of the tooth position because of outward oriented nipples and no hole-punching procedures as the nipples are easily cut. It offers maximum patient comfort and allows them to breath with no pressure around the nasal area.



Fig 6.5. Opti Dam

3. Lubricant

Before positioning the dam, it is an advisable to lubricate the inner surfaces well with Vaseline or, more simply, soap, so that the sheet will slide better over the contours of the teeth, more easily overcome the contact areas, and close tightly around the cervix of the tooth (Nidambur Vasudev Ballal *et al.*).

4. Rubber dam napkins

Rubber dam napkins prevent direct contact between the rubber sheet and the patient's cheek. By absorbing the saliva that accumulates beneath the dam by capillary action, they facilitate treatment. Their use is not mandatory; however, they are particularly indicated in cases of allergy to the rubber of the dam (de la Vega, 2008).

5. Dental floss

Apart from preventing the ingestion or aspiration of the clamp, dental floss is particularly useful for assessing the condition of the mesial and distal contact areas, and thus for facilitating the passage of the rubber sheet beneath them (Scardina, 2009).

C. Recent Accessory to Rubber Dam

1. Cushees

Cushees (Fig 7.1) are soft thermoplastic cashew shaped nodules which are grooved on their inner surface and act as rubber dam clamp cushions. It is slipped over the tooth attachment blade of clamp prior to clamp application. It increases patient comfort through elimination of contact of steel clamp with gingiva or tooth enamel, and thus helps to protect the natural tooth structure and costly restorations. It also enhances rubber dam seal to limit leaking from above or below the dam and reduces clamp slippage. They are sterilizable and reusable. It can be applied to one or both the jaws of rubber dam clamps.

They are available in two sizes: yellow for anterior and bicuspid clamps and blue for molar clamps.



Fig 7.1 Cushees

2. Wedjets (Hygienic)

Wedjets (Fig 7.2) are stretchable elastic stabilizing cords made from natural latex rubber and used as a rubber dam retainer. These are a faster and easier method of retaining the rubber dam than using conventional clamps. It is placed like dental floss over the rubber dam in the interproximal areas of the teeth, holding the rubber dam in position. It is available in extra small, small and large sizes. It reduces patient trauma and discomfort caused by metal clamps. They are especially used in the isolation of anterior teeth.



Fig 7.2. Wedjets

Conclusion

Even though the concept of absolute isolation was developed more than 150 years ago and despite its widely acknowledged benefits, a number of clinicians refuse to use absolute isolation in routine endodontic practice (Marshall and Page, 1990). The time it takes to achieve good isolation will pay itself forward exponentially in time as well as in quality of treatment and reduction of stress. Good isolation will preserve tooth structure, prevent contamination of the field, provide better visibility, and prevent iatrogenic misadventures (Anabtawi *et al.*, 2013).

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