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Rubber Dam in Restorative Dentistry

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of Restorative & Aesthetic dentistry in Partial Fulfillment for the Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled "Rubber Dam in Restorative Dentistry " was prepared by the fifth-year student Nada Bassam Hanna under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

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Dedication

This research is lovingly dedicated to my parents and friends who have been my constant source of inspiration. They have given us the drive and discipline to tackle a task with enthusiast and determination. Without their love and support this project would not have been made possible.

Acknowledgement

We thank Allah for giving us the strength and patience to achieve this work, which I wish, will be useful and objective.

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INTRODUCTION

The need to work under dry conditions, free of saliva, has been recognized for centuries, and the idea of using a sheet of rubber to isolate the tooth dates almost 120 years. Its introduction is attributed to Dr. Sanford Christie Barnum, who in March 1864 introduced rubber dam into dental practice **(Cardoso *et al.*, 2018)**. He demonstrated for the first time the advantages of isolating the tooth with a rubber sheet **(Elderton RJ, 1971)**.

It is surprising that even today the use of rubber dam for endodontics among general dental practitioners is low because a number of clinicians refuse to use absolute isolation in routine endodontic practice **(Marshall and Page, 1990)**. Many reasons such as, time for rubber dam placement, cost of equipment and materials, difficulty in use and patient acceptance are some of the disincentives to rubber dam use given by the dentists. The majority of these disincentives is based on unfound myths rather than evidenced based reasoning. It is worth spending a few seconds to organizing rubber dam for use in endodontic procedures and thus improves the entire treatment **(Ahmad IA., 2009)**.

Amongst all the methods of isolation of teeth, the ideal and the best method of isolation is rubber dam isolation. Professional organizations rubber dam is considered as the standard of care **(Maslamani, M. and Mitra, AK., 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, U., Hagglund, B., Sundqvist, G. and Wing, K. 1990).**

The use of rubber dam has become more critical not only for patients but also for the sake of dentists' safety especially during the epidemic spread of corona

virus along with other precautions as personal protective equipment, and patient screening, these were suggested for any treatment that produces aerosols and/or droplets **(A. Ather, B. Patel, N.B. Ruparel, et al., 2020).**

It has been reported that up to 70% of airborne particles could be reduced around a 3-ft diameter of the operational field when a rubber dam is used. In addition, a rubber dam is not only able to limit the diffusion of the aerosol but is also likely to dramatically reduce or even eliminate the presence of salivary components in the aerosol **(L.P. Samaranayake, J. Reid, D. Evans, 1989)**.

Also, protects from possible aspiration or swallowing of instruments, drugs, irrigating solutions, and tooth/material debris **(Schindler, 2008)**. At the end it is still the most ideal means of isolation till date (**European Society of Endodontology, 2006)**.

AIM OF STUDY

The aim of this project is to review the advantages of using rubber dam in endodontic practice, instruments needed in placing rubber dam and their advances, in addition to get the knowledge about recent alternatives and accessories of rubber dam, also methods of rubber dam placement in unusual situations.

ADVANTAGES OF USING RUBBER DAM DURING RESTORATIVE PROCEDURES

1. Provides dry and clean operating field.

2. Enhanced access, visibility to the working area and prevents iatrogenic misadventures **(Anabtawi *et al.*, 2013)**.

3. Protects patients from possible aspiration or swallowing of endodontic instruments, medicaments, irrigating solutions and debris **(Glickman GM, Pettiette MT, 2006).**

4. Retracts and protects the soft tissues (gingival tissues, tongue, lips and cheeks) against possible trauma from rotary and hand instruments and endodontic medicaments **(Pettiette MT, 2006).**

5. Significantly reduces the microbial content of air turbine aerosols produced during endodontic procedures, thereby reducing the risk of cross-infection **(Harrel SK, Molinari J., 2004).**

6. Improves the properties of dental materials by preventing the moisture contamination of restorative materials.

7. Enhances operating efficiency and increased productivity. Patient management is simplified by avoiding need to rinse the mouth of debris.

8. Protects dentists and dental assistants against infections which can be transmitted by the patient‘s saliva **(Harrel SK, Molinari J., 2004)**.

9. Minimizes patients’ conversation during root canal treatment and encourages them to open their mouth **(Bhuva B, Chong BS, Patel S., 2008)**.

10. Eliminates need for repeated change of cotton rolls due to flooding of saliva or root canal irrigants.

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

1. Patients with latex allergy
2. Asthmatic patients
3. Psychological reasons

INSTRUMENTS NEEDED FOR RUBBER DAM ISOLATION

1. Rubber dam sheets

In Endodontics, where one tooth is isolated at a time, the 5"x5" 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.

2. Rubber dam punches

Rubber dam punches are 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)**.

Figure 1: Rubber dam punches

3. Rubber dam clamps

The fit of the rubber dam essentially depends on the choice of the appropriate clamp and its correct positioning 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 clamps 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 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 # W8A IVORY # 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)**.

Figure 2: Rubber dam clamps

4. Rubber dam clamp forceps

Rubber dam forceps 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.

Figure 3: Rubber dam forceps

5. Rubber dam frame

Rubber dam frame 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.*, 1989)**.

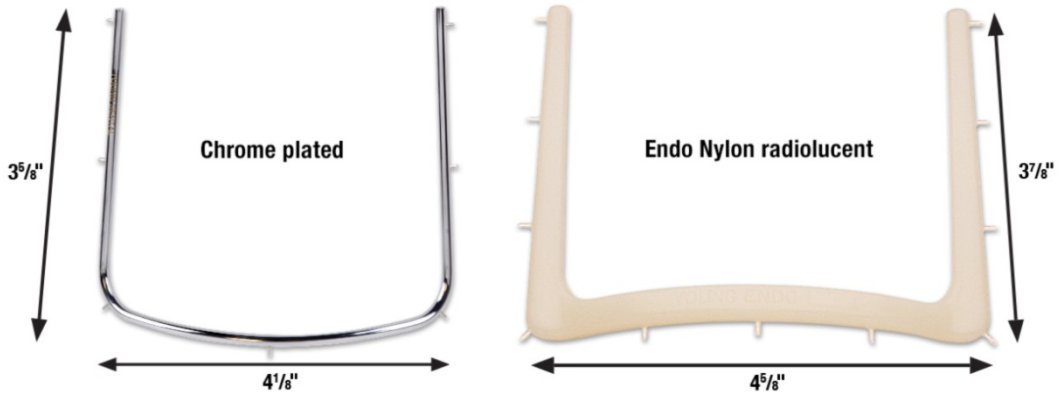

Figure 4: Rubber dam frames

6. Lubricant

Before positioning the dam, it is 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.*, 1939)**.

7. 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)**.

Figure 5: Rubber dam napkins

8. 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)**.

RECENT ADVANCES IN RUBBER DAM

1. Rubber dam sheets

1.1 Hygenic rubber dam

It is a non-latex rubber dam for patients with latex allergies. This powder-free, synthetic dam comes in one size (6×6 inches) and in one thickness (medium gauge). It has a shelf life of 3 years and has the same tensile strength of a latex dam.

1.2 Derma dam

It is also a non-latex 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.

1.3 Flexi dam

It is an elastic non-latex dental dam made from an elastic plastomer and can be elongated more than 1000 % before tearing. It is more tenacious than latex dam and is simple to place. It needs to be stretched before use. The punched hole should be 1 or 2 sizes smaller than normally used for latex dam. As the dam is non-latex and powder free, there are reduced chances of allergic reactions. It adapts extremely well around the cervix of tooth for effective isolation and an absolutely dry working area. It is available in blue and violet colour. These colours provide a good contrast to the working area and may have a calming effect on the user. This has an advantage while performing aesthetic treatment procedures.

2. 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.

2.1 Articulated frame

The articulated rubber dam frame is made of non-irritant plastic material (polysulfone) currently used in the agro alimentary industry, it has 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 anesthetic, 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 **(Sauveur G., 1997).**

Figure 6: Articulated frame

2.2 Safe T-frame

The Safe-T-frame (Sigma Dental Systems) 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.

Figure 7: Safe T-frame

3. Pre-framed dental dams

3.1 Insti dam (Zirc)

It 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-center 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.

Figure 8: Insti dam

3.2 Handi dam (Aseptico)

It 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.

Figure 9: Handi dam

3.3 Dry dam

It is an alternative type of rubber dam which does not require a frame. It consists of a small rubber sheet set in the center 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.

Figure 10: Dry dam

3.4 Framed Flexi Dam

The Hygenic non-latex flexi dam is also available with a convenient, built-in frame, the flexible frame is designed with a convenient working size of 100 mmx105 mm to ensure easy placement without limiting access. The dam has good tear resistance and is latex allergy free and odorless. The smooth surface of the plastic frame helps to maximize patient comfort when positioned against their skin.

Figure 11: Flexi dam

3.5 Opti Dam (Kerr)

Opti Dam is the first rubber dam with 3-dimensional shape and nipple design. The 3-dimensional shape of OptiDam 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. It 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.

Figure 12: Opti dam

3.6 Optra Dam

Optra dam represents the next generation of rubber dams, combining the benefits of a lip and cheek retractor (Optra Gate), with the total isolation of a rubber dam. The anatomical shape, high flexibility and patented inner-ring design allows it to be placed without the need for clamps. Additionally, there is no need for a separate rubber dam frame making it even more time and cost efficient. It is available in both regular and small sizes.

The soft flexible material allows patients to maintain full mobility of their jaw along with added comfort throughout the procedure. It provides optimum isolation as well as it is comfortable for the patient. Due to the enhanced flexibility of the plastic rings, it can be placed more easily in the patient's mouth. Its anatomical shape helps to create a considerably larger treatment field and complete isolation of both arches can be achieved at the same time.

Figure 13: Optra dam

2. Rubber Dam Clamps

2.1 Clamp with long guard extension

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. The larger wing of the clamp is used for the retraction of the tongue.

Figure 14: Long guard extension clam

2.2 Tiger clamp

These are the clamps with serrated jaws. These serrations will increase the stabilization of the clamp on the partially erupted or broken down teeth.

Figure 15: Tiger clamp

2.3 S-G (Silker-Glickman) clamp

This 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.

Figure 16: S-G clamp

2.4 Super Clamp

This new product facilitates the isolation of an individual tooth without covering the patients' whole mouth and nose. It protects the tongue and cheeks while helping the patient and the dentist feel more comfortable. The tongue will not need to be protected with the mouth mirror and hence it gives total security for treatment with the rotary instrument. The device consists of a specially designed clamp with an added wing extension to retract the cheeks and the tongue **(de la Vega E., 2008).**

This system comes with 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 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).**

Figure 17: Super clamp

2.5 Gold colored clamps

These clamps have diamond grit on their jaw to improve the retention of the clamp.

Figure 18: Gold coded clamps

RECENT ALTERNATIVES TO RUBBER DAM

1. Kool dam (Pulpdent Corporation)

It is a light cured material applied on the gingiva or tooth surfaces prior to power bleaching, sand blasting or other procedures requiring intraoral protection or isolation. It is also used to block out undercuts prior to taking impressions, also called as liquid rubber dam. Because of its low exothermic reaction, it eliminates burning and pain, thus assuring patient comfort.

It remains flexible after curing and has good tear resistance. It stacks on itself smoothly and evenly and is easy to remove. It is moisture friendly and works well in the oral environment and is a rubber dam substitute. A similar resin product called as OpalDam is manufactured by Ultradent Incorporation. It has two disadvantages. Firstly, being resin based, it produces heat when cured, and can thus cause discomfort or pain to the patient. Secondly, some of these products tend to displace and not stay where they are placed.

Figure 19: Kool dam

2. Fast dam

Anatomically-shaped fast dam is designed to provide a superior means of maintaining a dry quadrant field. It can be used in place of cotton rolls to retract the cheek and tongue while maintaining a dry field. Continuous aspiration is achieved by means of 17 suction holes along the perimeter, eliminating the need to change saturated cotton rolls while retracting the cheek and tongue. Fast dam fits into the valve of all standard saliva ejectors. Fast dam is also suitable when conventional rubber dam is too cumbersome.

Figure 20: Fast dam

3. Isolite

The Isolite is a new dental device that simultaneously delivers continuous throat protection, illumination, retraction and isolation. It has a unique soft, flexible mouthpiece which isolates maxillary and mandibular quadrants simultaneously, retracts and protects the soft tissues from accidental damage from high speed

turbines, delivers shadow less illumination and continuously aspirates fluids and prevents the aspiration of foreign objects. It can be particularly useful in young people with incompletely erupted teeth. Using Isolite, a core buildup during endodontic treatment can be done immediately by placing a matrix or core-former, and thus completing the process in one step. This reduces the amount of time and number of steps needed as compared to conventional rubber dam.

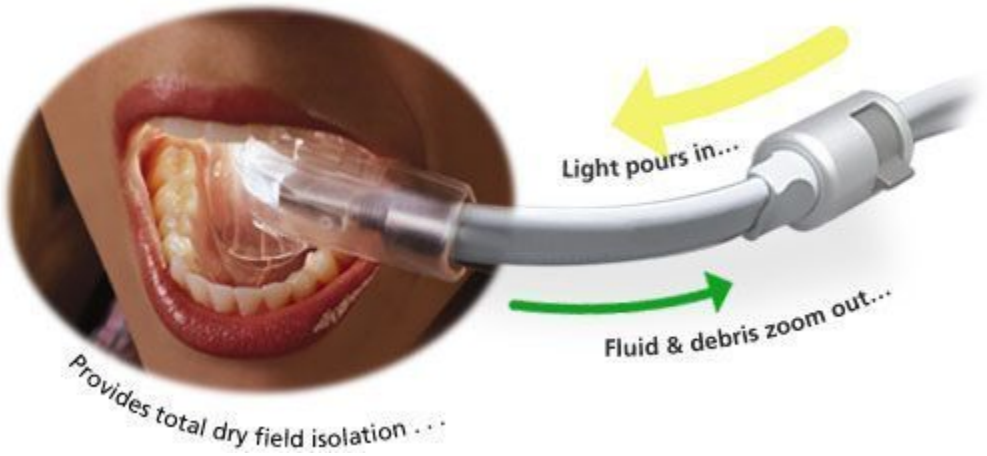

Figure 21: Isolite system

A similar device, Isodry, is also available which performs the same function, but requires external lighting. It has the following disadvantages:

1. It is significantly more expensive than the rubber dam.
2. It does not provide the color contrast with the teeth that some practitioners find helpful when using rubber dam.
3. It may cause damage to the gingiva, since Isolite does not seal the gingiva from irrigants or intra canal medicaments.

RECENT ACCESSORY TO RUBBER DAM

1. Cushees

These 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.

Figure 22: Cushees

2. Wedjets (Hygenic)

These 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.

Figure 23: Wedjets

METHODS OF PLACEMENT OF RUBBER DAM IN UNUSUAL TOOTH SHAPES AND POSITION

1. Partially erupted teeth or teeth with short clinical crown

These may need modified clamps:

1.1 Clamps with prongs inclined apically

This will help in engaging the tooth subgingivally **(Kenneth M. Hargreaves, Steven R. Cohen., 2010).**

Figure 24: Clamp prongs inclined apically

1.2 Self curing resin beads

Can be placed on the cervical area of the tooth, this will help in stabilizing the clamp in position during treatment **(Hajim Wakabayashi, Kouichi Ochi *et al.*, 1986)**.

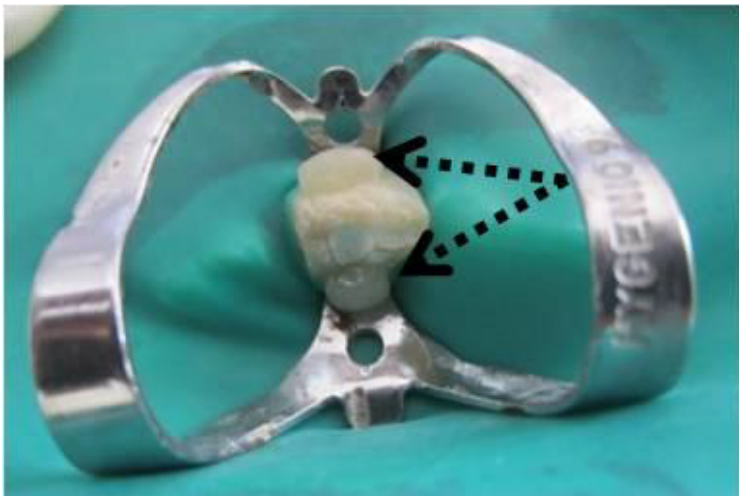

Figure 25: Rubber dam clamp stabilized by composite resin beads on central incisor with short clinical crown

Since a partially erupted tooth lacks undercut to retain the clamp, one can also place small acid etched composite lips on the teeth, which serves as an artificial undercut and remain on the teeth between appointments **(Arnaldo castellucci, 2004)**.

1.3 Tiger clamps

Serrations of the jaws help in stabilization of the clamp **(Ingle, Bakland, Baumgartner, 2008)**.

2. Severely broken down teeth

2.1 Modified clamps

Similar to those used for partially erupted tooth that is clamps with prongs inclined apically and tiger clamps. Apart from these S-G (Silker Glickman) clamp may also be used for severely broken down teeth, since its' anterior extension allows retraction of the rubber dam around the tooth in question with the clamp placed on the adjacent tooth **(Kenneth M. Hargreaves, Steven R. Cohen, 2010).**

2.2 Double clamp technique

Occasionally it might be possible to place the clamp in position, but due to inadequate tooth structure the elasticity of the dam might interfere in the stabilization of the clamp, in such circumstances one clamp is placed on the distal tooth that will take up the elasticity of the dam, whereas the second clamp is gently positioned on the tooth in question.

2.3 Split dam technique

In this technique two holes are punched in the dam that corresponds to teeth anterior and posterior to the teeth in question. The dam is then stretched over the clamped tooth and to the anterior tooth where the dam is stabilized with the widget. The dam between the holes is then cut with scissors.

Figure 26: Split dam technique

2.4 Use of copper band

In this method a copper band is heat softened. It is then trimmed such that it adapts to the gingival contour of the tooth. The band is closely and passively placed over the remaining supra-osseous tooth structure. Because of the flexibility of the softened copper band, it can be pressed over the supra-osseous tooth structure and pushed sub-gingivally with minimal trauma **(Ronald Linden, 1999).**

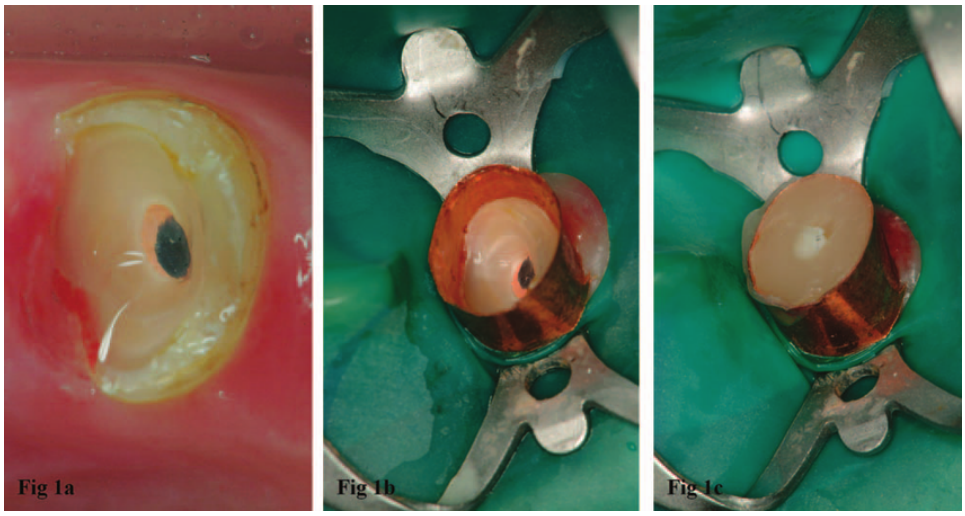

Figure 27: Copper band with rubber dam placement

2.5 Temporary crowns

Can be cemented over the remaining tooth structure, access cavity preparation is then made through the crown **(Ronald Linden, 1999).**

3. Crowded teeth

In case of crowded teeth there is no enough space to place the clamp in position, in such a situation rubber dam is placed on to the tooth which is teased beneath the contact area with the help of floss and is stabilized by two fragments of the dam instead of the clamp **(Arnaldo castellucci, 2004)**. Widgets can also be used in place of dam.

Figure 28: Rubber dam placed on crowded anterior teeth

4. Teeth with orthodontic wire

Orthodontic wire prevents tight sealing of the rubber dam sheet. Tight seal can be achieved by the use of oraseal, orabase, periodontal dressing, mixture of dentin adhesive and zinc oxide powder (PGZ) **(Manuel I. Weisman,1991)**. Oraseal being the material of choice, other method is to position the clamp above the orthodontic attachment **(Arnaldo castellucci, 2004)**.

Figure 29: Rubber dam placement on orthodontically treated teeth further sealed with orasele

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