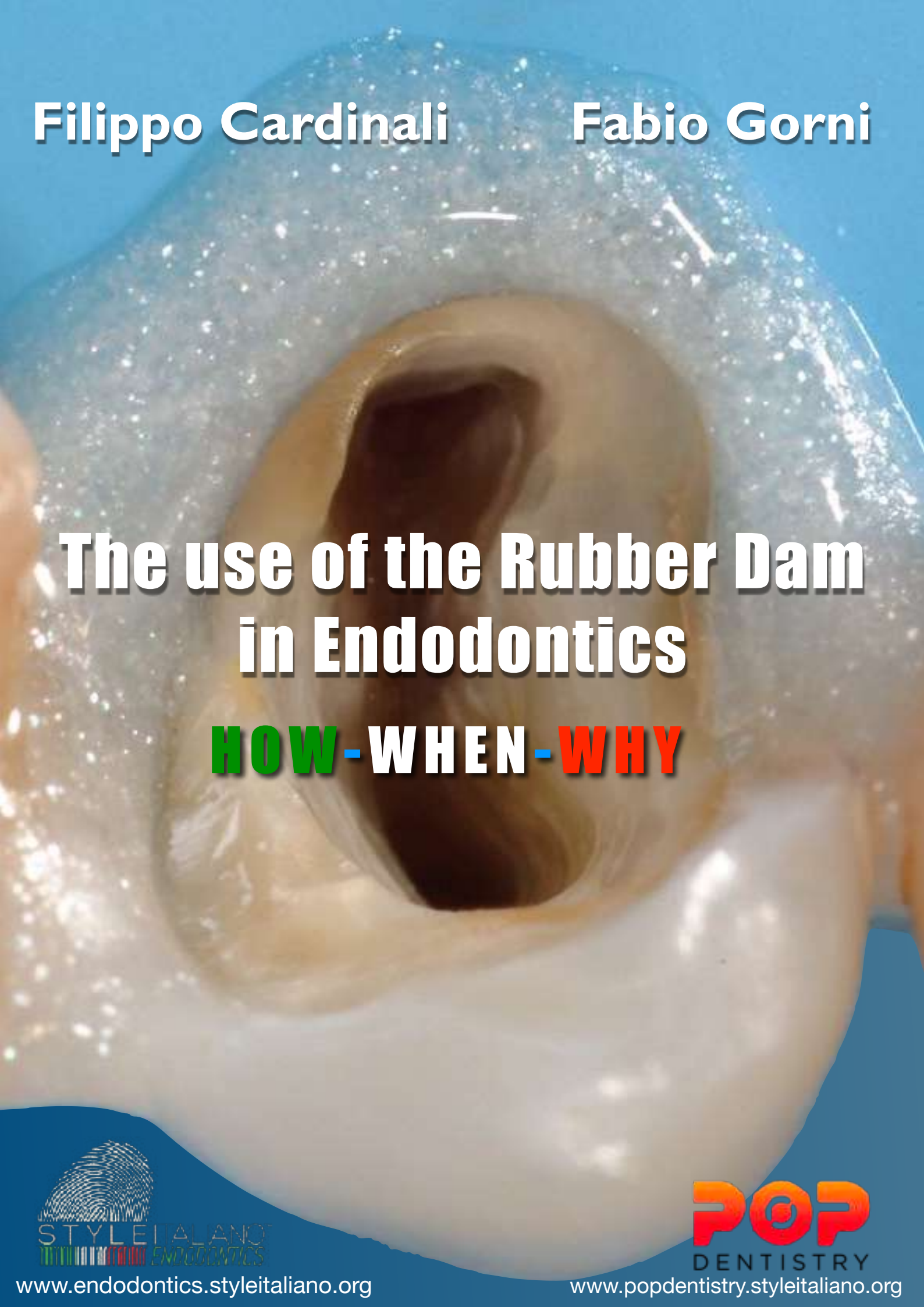
Filippo Cardinali Fabio Gorni



The use of the Rubber Dam in Endodontics

HOW - WHEN - WHY

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INTRODUCTION

Nowadays the endodontic world is crazy for the technology, rotary instruments, endo motors, microscopes and so on, but some colleagues are loosing the attention on the basic principles of the root canal treatment underestimating the importance of the isolation in endodontics .

The rubber dam is still the first and the most important step of our treatment, not only to avoid infections but also to improve the access and the visibility of the operative field.

StyleItaliano Endodontics motto is feasible, teachable and repeatable that's why we are happy to introduce to all of you this practical manual, easy to consult and useful for your daily practice.

It's a great pleasure for us to give you this book for free, as acknowledgement for all our followers.

Stay tuned and follow us on Styleitaliano Endodontics.

Fabio Gorni Pio Bertani

Styleitaliano Endodontics Founders

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FOREWORD

In the last few years, scientific research and progress have revolutionized every field of dentistry by developing groundbreaking materials and techniques. We have nickel-titanium rotary instrumentation, ultrasonic cleaning, new locking systems and the utilization of light sources and operating microscope in endodontics. In restorative dentistry the evolution of composite materials and the implementation of rational layering techniques has allowed the clinician to perform highly aesthetic and mimetic, direct and indirect dental restorations.
As a result, materials once deemed fundamental in their own field – e.g. dental amalgam in restorative dentistry and steel instrumentation in endodontics – experienced an abrupt and severe reduction in their operative use.
In the pursuit of excellence, practitioners are often focused on the use of new equipment and techniques with the consequential risk of lessening or even discarding some fundamental operative steps such as operative field isolation.
Among the few procedures not to be affected by this revolution, the usage of dental dam is still considered an essential step in a rational and predictable endodontic and/or conservative procedure.
By talking about operative field isolation, the Authors aim at demonstrating that the application of the dam is an easy, essential and accessible step for all practitioners. The dam is not meant to be used by a small, privileged elite: it represents a simple and affordable solution for the practitioners who want to perform their job according to correct biological and ethical guidelines.
Having a clear view means less stress, makes the job easier and simplifies the management of several factors, e.g. saliva and soft tissues. This is all about a different professional approach: to isolate means to respect one's work and prolong one's professional life. When we use a dam we are caring about the patient, but even more about ourselves.
When fully aware about dam advantages, the practitioner will be sure to do the best for the patient and he/she won't easily give up this habit even in the most difficult cases. In fact, in the most challenging clinical cases the advantages attributed to correct operative field isolation should act to motivate the practitioner to use the dam: for over a century this has been the very first step toward excellence in conservative and endodontic dentistry.
In more than twentyfive years of a career in dentistry– partly devoted to professional training – we have never met any colleagues quitting the dam after learning and appreciating to operate in an isolated field: our job is not quite easy… there is no point in making it harder!
For this reason, as well as for undeniable clinical and biological advantages, the dam should be seen as the best way to ease one's own professional life and achieve one's full potential with minimum effort and time spent.
This is our philosophy since day one. For those who prefer blood, sweat and tears, this book is not for you…

Fabio Gorni

Filippo Cardinali

Chapter I

HISTORY AND RATIONAL REASONS FOR USING THE DAM: PROS AND CONS

HISTORY

The invention of the rubber dam isolation technique dates back to 1864 in New York, when young dentist Sanford Christie Barnum (Fig. 1) finally found a solution to prevent the contamination by oral fluids of the target tooth during fillings.

He took a rubber sheet, pierced it and tied it to the tooth to be filled with a silk floss, thus obtaining an operative field with a humidity control which was definitely superior to the one achieved by the means used so far.

This cutting-edge technique became widespread and in the following years some tools were introduced to make the application easier.

Dr Barnum himself designed a set of steel clamps to stabilize the dam around the tooth.

Fig. 1. Dr. Sanford Christie Barnum

In 1873 the plier designed by Dr Royce to ease tooth clamping procedure was already available for sale, while in 1875 Dr Delos Palmer introduced a set of 32 clamps, each one designed for a specific tooth (Fig. 2).

Subsequently, in 1879 Dr Ainsworth launched the rubber dam punch plier, which remained almost unchanged compared to the present version (Fig. 3).

In 1901, with the introduction of the metal frame by Dr Young, the core instrumentation to achieve proper operative field isolation was complete: rubber sheet, punch plier, clamp set with dedicated plier and metal frame to stretch the dam.

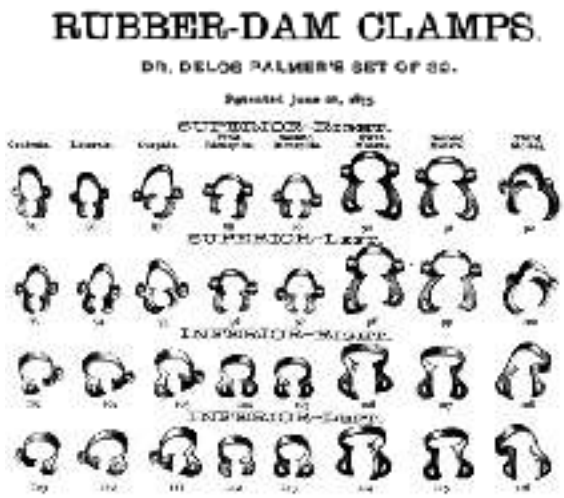


Fig. 2 Dr. Palmer's clamp set.

Fig. 3 Ainsworth's rubber dam punch plier.

RATIONAL REASONS FOR USING THE DAM

All clinical procedures must follow reliable and predictable operative protocols based on evidence-based theory, and operative field isolation is no exception.

The international scientific literature base contains a plethora of novel operative modalities and techniques.

Through the thorough assessment and analysis of a given technique within a treatment modality its relative merits and disadvantages can be ascertained it is a banality to say that scientific literature has everything and its opposite, so it can be often more ambiguous than clear-cut about techniques and clinical procedures.

Thankfully this is not the case when it comes to operative field isolation. In fact, there is no conservative or endodontic dentistry textbook where the utilisation of the rubber dam is described as an optional treatment step.

Comprehensive operative field isolation is considered as one of the key steps for a predictable clinical result.

When a patient, for example, asks the success rate of the orthograde root-canal retreatment of his/her tooth, the dentist's answer refers to figures published in literature and the treatment plan is proposed and often agreed upon with the patient accordingly.

When providing the patient with correct information, the dentist must be aware that those success rates refer to strict clinical protocols including rubber dam usage.

Barnum introduced the isolation technique to improve procedural quality.

After more than 150 years, Barnum's vision is still vivid and effective: as a matter of fact, adhesive techniques being largely used in modern conservative dentistry demand absence of humidity to be properly carried out and the asepsis of the operative field is vital to endodontic treatment success.

However, academic approval is not matched by the same enthusiasm in practitioners' world.

Actually, the percentage of practitioners performing operative field isolation as a standard procedure in endodontic and conservative treatments is low, with remarkable differences based on nations surveyed and practitioner's specialization degree. In the United States of America, dentists specialized in endodontics use the dam in 100 percent of the cases, while General Dental Practitioner (GDP) use it in about 60 percent of the cases. In Europe, instead, the dam is used as a standard procedure by GDP in much lower percentages, ranging from 3 to 20 percent based on nations surveyed.

This difference between United States and Europe is probably due to a variety of factors, not least that rubber dam application in Endodontics in USA is considered as a standard of care and its usage is mandatory in case of legal/ medical controversy.

There is no rational basis to carry out treatment without the rubber dam: the advantages connected to it are clear and undeniable for the skilled practitioner, who gets to know and appreciate them day by day.

ADVANTAGES

The advantages connected to the dam are well known and have been acknowledged by international scientific community since its introduction in clinical practice.
Using the dam surely offers a better and more comfortable access to the operative area (Figs. 4-5).
When the rubber sheet is stretched over the frame, soft tissues like lips, cheeks and tongue are retracted and simultaneously sheltered from the cutting action of burs and other tools.
In patients with a shallow mouth floor the dam is the best solution to prevent sub-lingual glands from being wounded by burs.
Retraction offers better access and increased visibility in the operative area providing the practitioner with great comfort, especially with patients showing a small *rima oris*, poor buccal opening or hypertonic tongue and facial muscles (Figs. 6-9).
Since the days of Hippocrates, one of the core principles of operative manoeuvres is to achieve adequate access to the operative field. Thanks to Barnum this concept became applicable to dentistry and, to this day, there is no other comparable technique to further increase operative area accessibility and field view. This is a vital topic for dentistry since most of the mistakes are due to working in small-sized cavities where it is difficult to see what you are doing. A wider access with improved visibility allows the practitioner to work more effectively and stress-free. As for visibility, the dam offers one more highlight: when the target tooth has been isolated, the practitioner has a clearer and more detailed view improving his/her technical skills and enhancing performance. This is attributed to the fact that the eye is no longer "distracted" by the tooth's peripheral areas. Without the dam, instead, it tends to enlarge its visual field due to elements drawing its attention such as cotton rolls or tongue and floor of mouth movements. The dam manages to visually remove these interferences and the eye can focus itself on a single tooth.

Fig 4-5. Small *rima oris* and hypertonic tongue in a patient needing endodontic treatment on 3.7.

Fig 6-7. Patient with small *rima oris* needs endodontic treatment on 1.7.

Fig 8-9. The application of the dam increases the visibility and the access to the operative area.

ADVANTAGES

Increased working comfort arising from operative field isolation has several explanations. First, once the dam is placed, the practitioner and his/her assistant avoid "wasting" a hand to retract tissues. This greatly increases operative efficacy: the practitioner can use the free hand to reflect the lamp light more accurately with the dental mirror while the assistant can hold a second suction cannula.

When the practitioner has indirect vision during cavity preparation the assistant will be able to properly manage the operative field by holding the suction cannula while simultaneously blowing air with the syringe on the dental mirror, to keep it dry and provide the practitioner with an optimal view. Finally the patient cannot interact with the practitioner, e.g. by asking to rinse his/her mouth or to rest for a while.

Together with improved visibility and absence of waiting times to replace cotton rolls or dry tips, these factors aid in allowing a continuous procedure thus leading to a further benefit: operative time reduction. Regardless of what operative field isolation naysayers may think, the few seconds – or minutes – spent to place the dam are largely made up for during the whole performance. Using the dam is also important for practitioner's and patient's own safety: with the dam on, the patient is protected against the swallowing or inhaling of foreign bodies (root-canal handfiles, burs, etc. ...), root-canal exudates and irrigants (Figs. 10-11). Furthermore the dam cuts down the risk of infectious diseases that are transmitted through blood and saliva, by reducing the aerosol inhaled by the practitioner originating from the organic hard and soft tissues of the patient.

Working in a perfectly clean and dry operative field provides practitioner with a more detailed view of the working area; additionally it prevents any form of contamination by oral fluids, a crucial factor for the quality and success of endodontic and conservative treatments.

The final benefit is of improved patient comfort, who is quite glad not to feel his/her mouth crowded with hands and surgical tools thanks to this use of the rubber dam.

Rubber dam therefore allows optimal conditions for the practitioner, the patient and the materials used in endodontic and conservative treatments, contributing to

Fig 10. The dam prevents oral cavity contamination by root canal exudates.

Fig 11. The dam prevents the patient from accidentally swallowing root-canal irrigants.

WHY TO USE THE RUBBER DAM IN ENDODONTICS

In 1923 the New York First District Dental Society established the importance of carrying out root canal treatment in a clean and dry operative field, outlining how using a rubber dam would have been the best method to achieve this goal.
In the same year the New York Academy of Medicine acknowledged that not using the dam in endodontic dentistry could be detrimental to the treatment, which would have been no more performed in the patient's best interest. The dam is the only way to prevent both endodontic contamination by oral cavity bacteria and extrusion of exudates and/or root canal irrigants into the oral cavity(Fig. 12).
From a microbiological point of view, root canal contamination during orthograde treatment is the reason why the micro-biological composition found in re-treatment cases is different from the one in primary root canal infections (Fig. 13).
Thanks to the use of the rubber dam, the irrigants can work properly as their action is not compromised by the contamination arising from saliva and bacteria of the oral mouth, so basically we can conclude that the disinfection of the root canal system begins with a non-contamination, that means with the proper application of the dam (Fig. 14).
It should nevertheless be considered that there are no randomized clinical studies comparing success rates between dam-based or dam-free treatments.
Moreover in endodontic treatments there is a multitude of critical success factors and the isolation is just one of them: as clinicians we have to carry out properly all the stages of the Endodontic treatment, from diagnosis to coronal seal, to increase the chance of getting the positive outcome of the therapy.
Understandig the role of the isolation in Endodontics is even important for the decision making
When a patient asks for the orthograde root canal treatment/retreatment success rate, our answers always refer to official literature data upon which treatment plan is proposed and often agreed.
When providing the patient with correct information, practitioner must be aware that success rates refer to strict clinical protocols which are always based on dam usage. It should also be remembered that, besides the advantages already listed, the dam is the only tool to avoid accidental swallowing/inhaling of tools.
Using the dam also improves shaping quality: without the dam, in fact, mostly in posterior regions the practitioner tends to firmly grasp the tools out of fear they can slip from fingers. In these situations, especially with curved anatomies, the risk is to shape a "step" which might be hard to subsequently climb over, causing the section that is apical to the "step" to be left unshaped, poorly cleansed and unfilled, thus lowering remarkably treatment success rates. Instead the dam will provide the practitioner with the utmost sensitivity while using tools.

Fig 12. The dam prevents the patient from accidentally swallowing root-canal hypochlorite during the irrigation.

ADVANTAGES

Fig 13. A proper cleaning of the root canal system is really important for the outcome of the therapy, the proper disinfection begins with a non-contamination of the root canal system.

Fig 14. Bacteria sustaining the periraducular infections are different in the 2 groups. In the group of already treated teeth it is possible to find bacteria arising from the oral mouth as the *Enterococcus Faecalis*: these bacteria probably arrived in the root canal system during the primary treatment done without the rubber dam.

DISADVANTAGES

There is no established scientific evidence describing the disadvantages arising from correct dam utilization.

Nevertheless there are some relative contra-indications to the application of the rubber dam as the presence of respiratory tract obstructive diseases or acute infections.

These diseases are regarded as a strict contraindication to dam usage that should be postponed until their complete resolution.

Even though claustrophobia is an obvious and severe contraindication to dam usage, still the practitioner can put the patient at ease with some professional courtesies (piercing the sheet away from the operative area to provide the patient with an air flow to the oral cavity and adopting a proper psychological approach) to increase the chances of performing isolation anyway (Figs. 15-16).

Epilepsy and other motor disabilities are included in the dam contraindications: precautions to be adopted with these patients should be done on a case-by-case process.

Despite few valid contraindications, operative field isolation is a widely misunderstood and poorly used operative procedure among practitioners, whose main objection is their patients' dislike toward dam application.

Studies on patients have actually shown that dam acceptance rate is high when the dentist explains its advantages before application.

Motivating patients to use the dam is a very crucial factor: properly motivated and well informed patient will readily understand that using the dam can improve treatment quality and outcome, thus raising no objections to its usage.

Fig 15. Piercing the dam away from the operative area is a good strategy to increase compliance in difficult patients.

Fig 16. The hole can be used as an access for suction cannula.

Chapter 2

OPERATIVE FIELD ISOLATION: ARMAMENTARIUM

ARMAMENTARIUM

In order to easily isolate operative field even in difficult situations, practitioners must know the characteristics and correct function of his equipment.

RUBBER SHEETS

The rubber dam sheet can be made of latex or synthetic material. Latex is a complex emulsion with two main features: **elasticity** and **resilience**, that is a material's capacity to come back to its original shape after being twisted or squeezed (Fig.1-2).

These features are very useful during isolation since the hole in the sheet has always a smaller diameter than the tooth.

Elasticity prevents the sheet from tearing apart when the practitioner stretches it to fit it around the tooth clinical crown.

Resilience contributes to a perfect seal since the sheet adheres firmly to the tooth neck (*cervix*).

Powder-free latex sheets for people suffering from contact dermatitis and synthetic material latex-free sheets for latex-allergic patients are available; it ought to be remarked however that these dams are less elastic and less resilient compared to the latex ones.

Rubber sheets width ranges from 0.13 to 0.29 mm, application fields and placement procedures may vary accordingly: a bigger width will improve protection and soft tissue retraction, but sliding the dam within interproximal spaces will be harder.

Rubber sheets come in different colors: conservative dentistry requires dark colors to contrast restoration materials, while in endodontics a light-colored dam makes the operative field brighter and the intra-operative radiography easier (Fig. 4).

Fig. 1-3. Amongst punch plier holes, the biggest one has a diameter of about 2.3 mm. Due to latex **elasticity** the hole can be stretched open up to 3 cm without tearing. Once the pressure is removed, the hole takes back its original shape due to latex **resilience**.

Fig. 4. Rubber sheets come in different colors: conservative dentistry requires dark colors to contrast restoration materials, while in endodontics a light-colored dam makes the operative field brighter and the intra-operative radiography easier

RUBBER DAM PUNCH PLIER

The two more common types of rubber dam punch pliers available are the Ainsworth type (Figs. 5-6) and the Ivory type (Figs. 7-8).
These pliers differ in mechanics but they both serve the same purpose, which is piercing perfectly round holes with variable diameter on the rubber sheet.
The round-shaped hole rim improves resistance to tearing when the sheet is stretched and placed upon the tooth (Fig. 9).
As for diameters, the largest hole is usually selected for the tooth to be clamped, while gradually smaller diameters are used to other purposes (isolating molars, premolars, canines and incisors).
A misuse of the piercing technique or incorrect maintenance of the punch plier can lead to an inaccurate hole with rim irregularities (Figs 10-12).
This can result in the sheet being less resistant to tearing during its placement and it loses the ability to perfectly adhere to the tooth neck with the possibility of saliva leakage (Figs. 13-14).

Fig. 5, 6. Sanctuary Ainsworth Rubber Dam Punch.

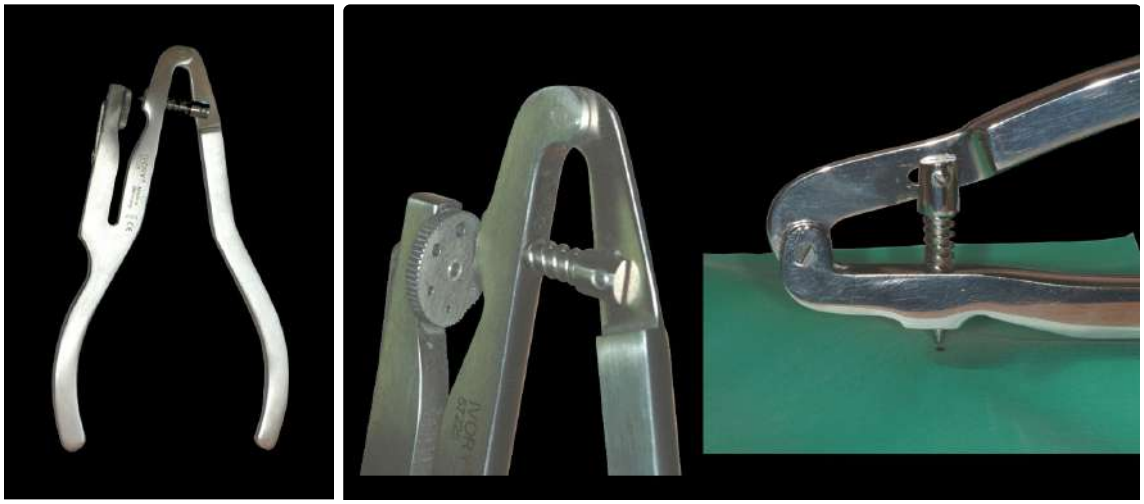


Fig. 7, 8. Ivory Rubber Dam Punch.

RUBBER DAM PUNCH PLIER

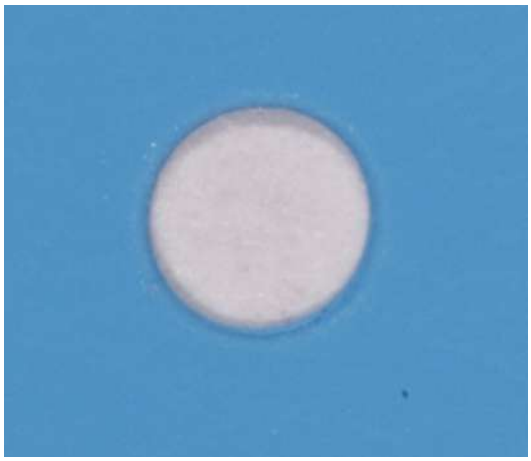


Fig. 9. Perfectly round-shaped hole made with a punch plier.

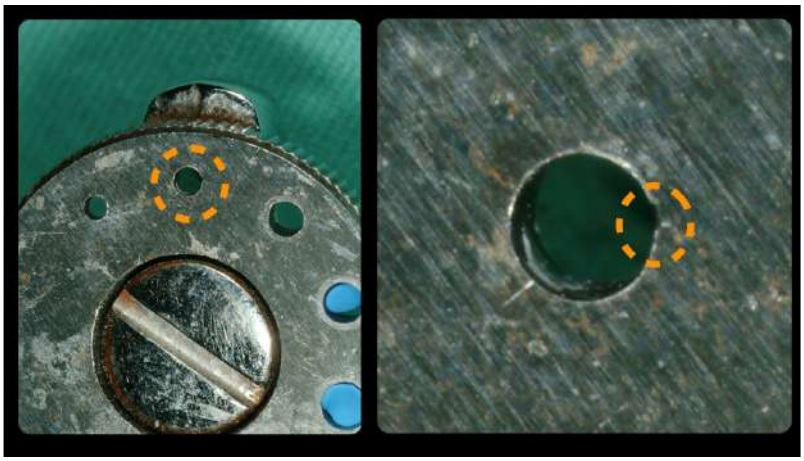


Fig. 10,11. A misuse of the punch plier caused a notch in the hole circumference.

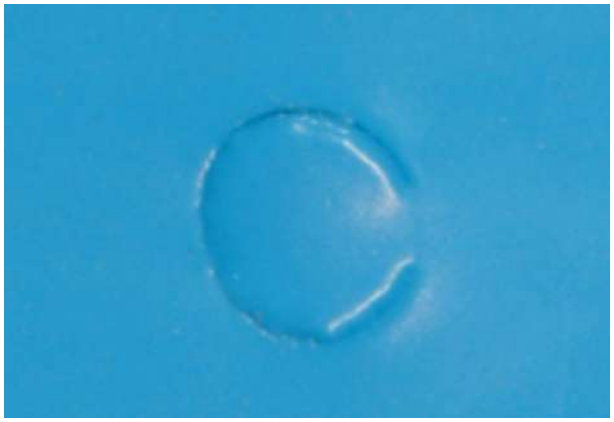


Fig. 12. Irregularity is transferred to the sheet during piercing.

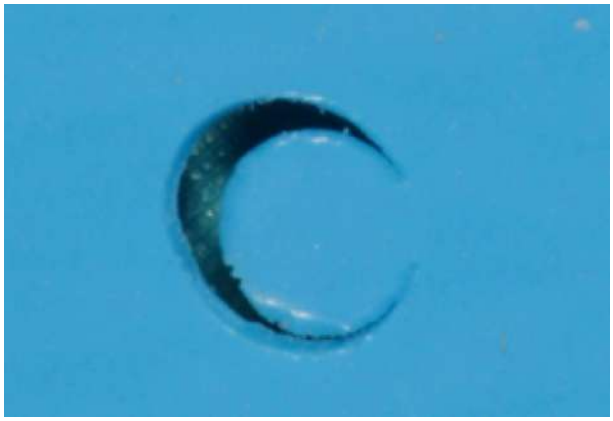


Fig. 13. If the hole-punching revolving head is worn down, the piercing will be incomplete.

Fig. 14. The elimination of the rubber stem causes an irregular and less resistant hole.

CLAMPS

Clamps are needful to secure the rubber sheet to the tooth. Models available for sale are classified by manufacturing companies in three main groups: anterior teeth clamps, bicuspid teeth (premolars) clamps and molar clamps.

In order to choose the right clamp (see Chap. 5), the practitioner must understand their structure and mechanics (Fig. 15). A clamp has two main components: bracket and branches.

The bracket is the metal arch connecting the two branches and providing them with proper compressive strength to anchor themselves to the tooth.

The manufacturing company's name and a number coupled – or not – with a letter to identify clamp pattern and style are usually engraved in the bracket.

In the branch there is a hole for the clamp plier, otherwise you can always find a notch where clamp plier is engaged. Upon the branch outer surface there may be a bulge which is called *wing*: clamps without wings have the letter "W" (wingless) engraved in the bracket before the serial number. The inner side of the branch is called "jaw" and it can be smooth or edged. At both sides of each jaw there are two sharp endings points called "prongs" "contact points", adding to a total of 4 points each clamp. The jaw angulation may vary according to the clamp type and it is very important from a clinical point of view: clamps with slightly tilted or flat jaws are actually recommended for teeth with intact clinical crown (Fig. 16), while clamps with angulated jaws are made to reach the tooth at gingival sulcus depth, so they are recommended for teeth with damaged clinical crown (Fig. 17).

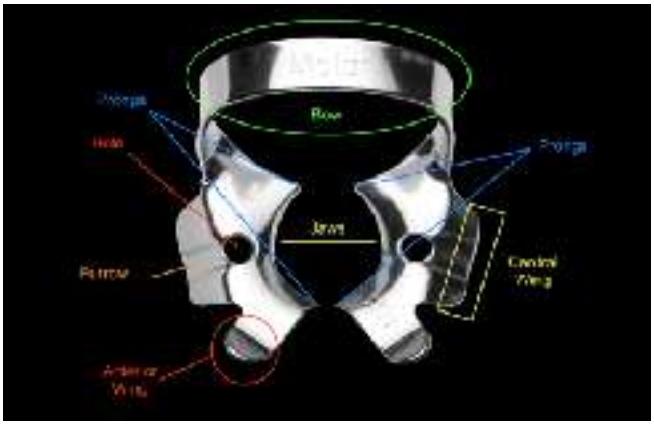


Fig. 15. The several parts forming Sanctuary clamp 201.

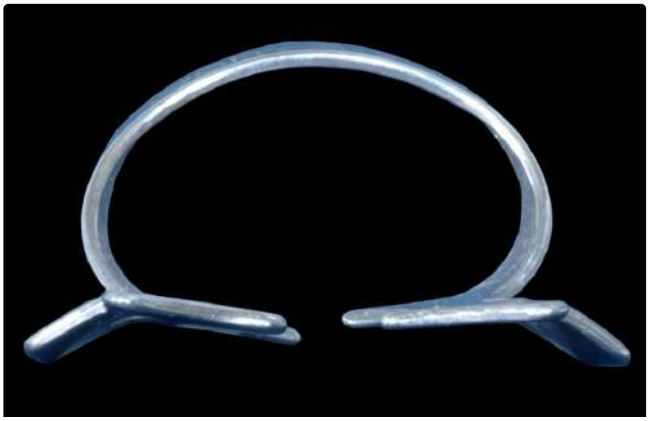


Fig. 16. Flat-jawed clamp 7 is recommended for teeth with intact clinical crown.

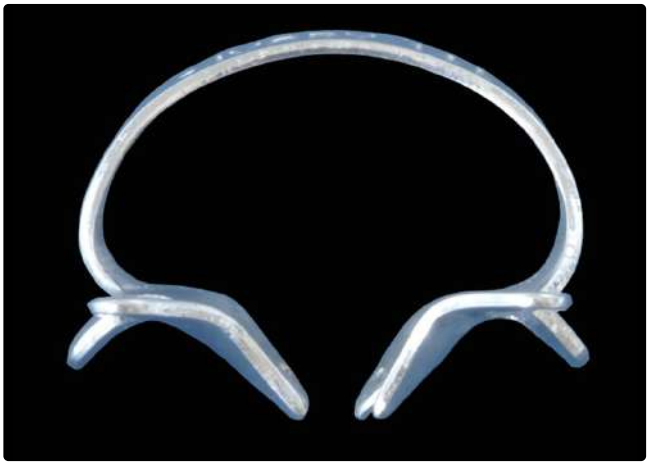


Fig. 17. Tilted-jaw clamp 14 should be used with damaged clinical crowns.

RUBBER DAM FORCEPS

The rubber dam forceps is the tool used to take the clamp to the mouth and to place it upon the tooth. By closing the plier with a pressure on its handles, the clamp is stretched out. to reach its final position and to overcome – if any – the clinical crown circumferance. When the clamp is on, the practitioner can gently release the plier handle so the clamp can return to its rest position and the tooth structure experiences a gradual pressure without abrupt shocks. The featured cross-locking system is useful to bring the clamp to the mouth easily (Fig. 18).

Fig. 18. Sanctuary Rubber Dam Forceps.

FRAMES

The frame plays a lead role in operative field isolation.

Because of this extra-oral anchorage the stretched-over sheet is actually capable of keeping soft tissues retracted for the whole treatment duration, thus offering better working access.

Metal and transparent plastic frames with different shapes are available.

The Metal "U shape" frames are recommended for conservative dentistry (Figs. 19-21), while the plastic version (Fig. 22,23) is used in endodontics because they are radio-transparent (so avoid interfering with intraoperative radiography).

Amongst radio-transparent plastic frames, the Nygaard-Ostby type is very functional to endodontic treatments: the octagonal shape fits very well to the patient's face avoiding operative field contamination and allowing for intra-operative radiography without disas-sembling the sheet from the frame (Figs. 24-28).

Fig. 20. Pre-operative access to quadrant I before field isolation.

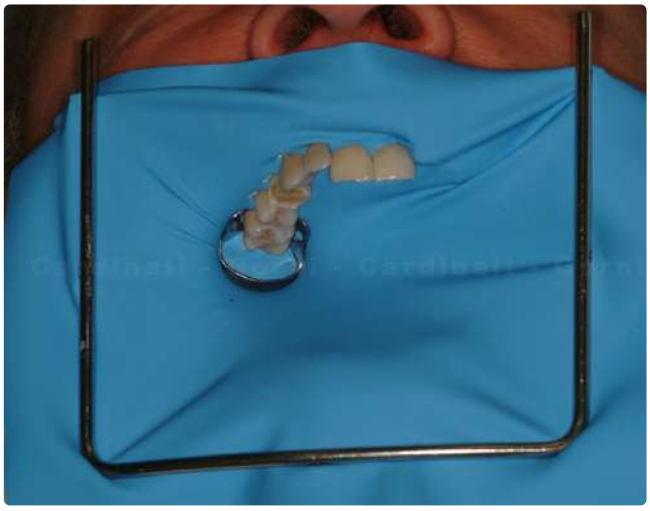


Fig. 21. Improved access and visibility to quadrant I after dam placement.

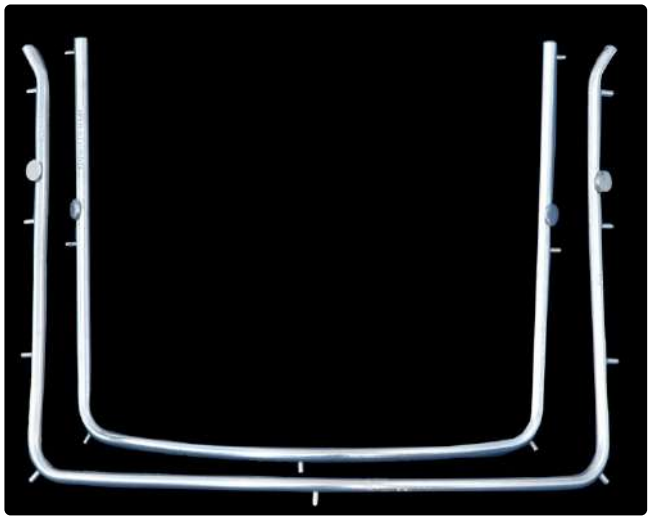


Fig. 19. Metal "U shape" Frames.

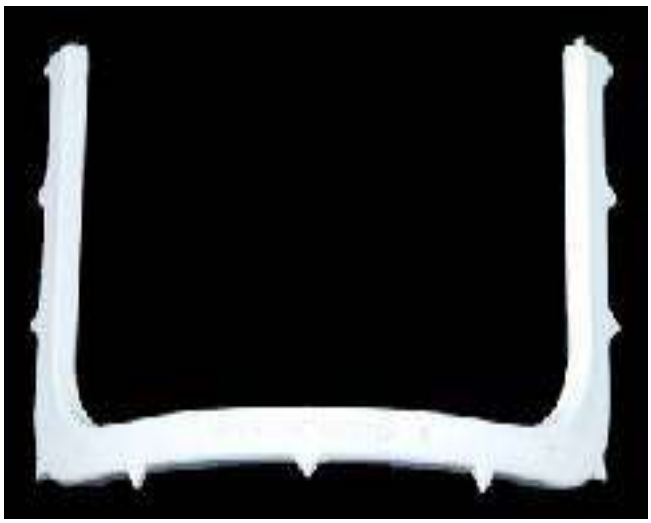


Fig. 22. Plastic "U shape" Frame.

FRAMES

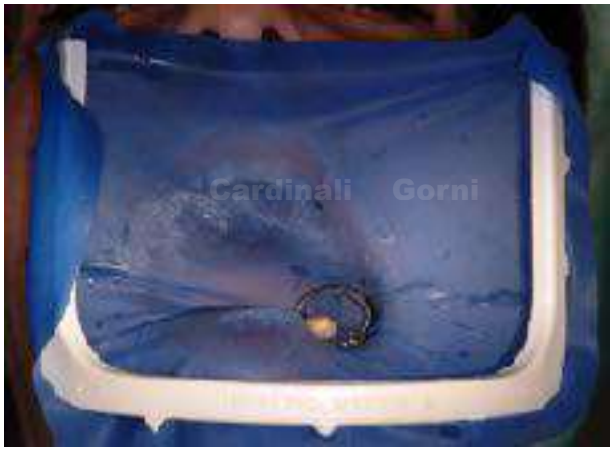


Fig. 23. Plastic "U shape" Frame.

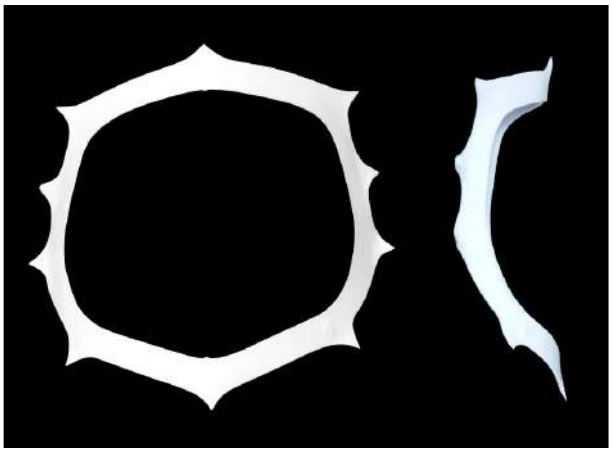


Fig. 24. Radio-transparent plastic frame (Nygaard-Ostby type).

Fig. 25. Once the Nygaard-Ostby frame is placed, the exceeding portion of the perimetral dam can be cut with scissors.

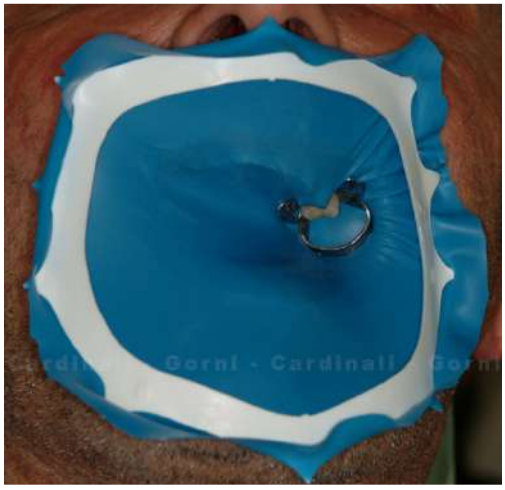


Fig. 26. When the exceeding sheet has been removed, the frame-dam unit fits very well to the patient's face.

Fig. 27. The frame prevents operative field contamination by nose exhaling and allows for intra-op radiography.

Fig. 28. Intra-operative radiograph of the case in Fig. 27.

AUXILIARY SISTEMS

Auxiliary systems cover any other pieces of equipment of kit that facilitate the placement and management of an isolated operative field.
In this category we find dental floss (which is used to slide the dam within interproximal spaces and to carry out ligatures), stamp and templates (so the practitioner can pierce the rubber sheet in the correct position and with the utmost accuracy), and the rubber bands attaching the dam to the teeth.
Practitioners can also use little paper towels to be placed between the dam and the patient to prevent rubber sheet from touching the skin: their use provides the patient with more comfort and it is recommended during long-lasting sessions (Figs. 29, 30).
Glass ionomer cements and liquid dams belong to the auxiliary systems' family: the practitioner can use them to obtain a good seal when the clamp-dam unit is not fitting tightly to the tooth neck (more on that later) (Figs. 31,32).

Fig. 29. The paper towel is inserted between the patient's face and the rubber sheet.

Fig. 30. The paper towel avoids the contact between rubber sheet and skin, thus improving patient's comfort.

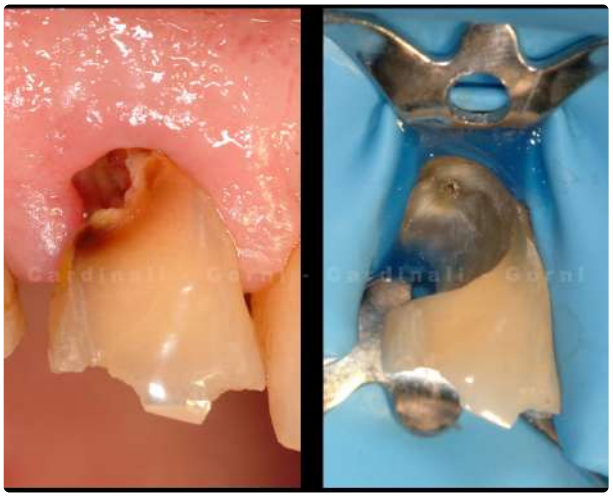


Fig. 31, 32. The liquid dam offers a good seal even in difficult situations.

Chapter 3

ISOLATION: AIM & PLANNING

ISOLATION AIM

Advantages arising by the application of the dam were already described in the Chapter 1; now it's time to go deep on the characteristics the isolation needs to get all the benefits for the endodontic treatment.

By using the rubber dam the practitioner aims to achieve a stable and leakage-free (to and from the oral cavity) operative field for the whole treatment duration.

In Endodontics this goal can be simply accomplished provided the practitioner has a thorough knowledge of instrumentation characteristics and functioning.

Operative field stability depends on proper clamp positioning (Figs. 1-4) while leakage control may vary between conservative and endodontic dentistry.

In conservative dentistry the rubber sheet must perfectly adhere around the tooth neck, whilst in endodontics, once the clamp is stabilized, leakages are controlled by auxiliary systems (Fig. 2).

If the chosen clamp is the right one and there are no leakages, this will facilitate effective treatment and the isolation objectives will be fulfilled (Figs. 3,6-7).

To resume, the purpose of the isolation is the creation of an operative field with the following characteristics:

- Stable
- Leakage-free
- Made to last for the whole treatment time

Fig. 1. Clamp is correctly positioned and the operative field is stable; there are gaps allowing the passage of fluids from and to the oral cavity.

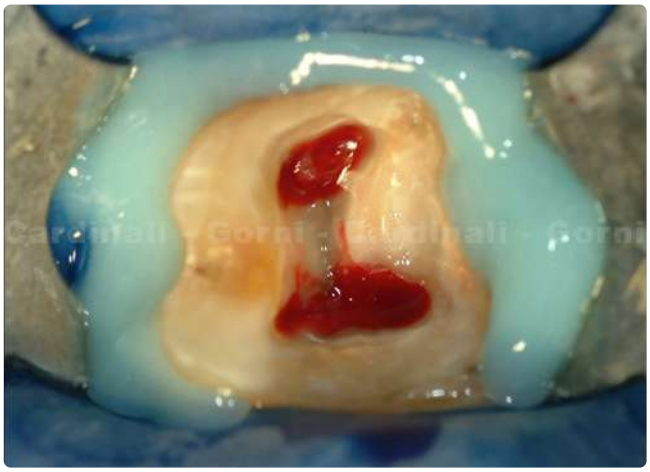


Fig. 2. Operative field seal and leakage control are obtained thanks to the liquid dam.

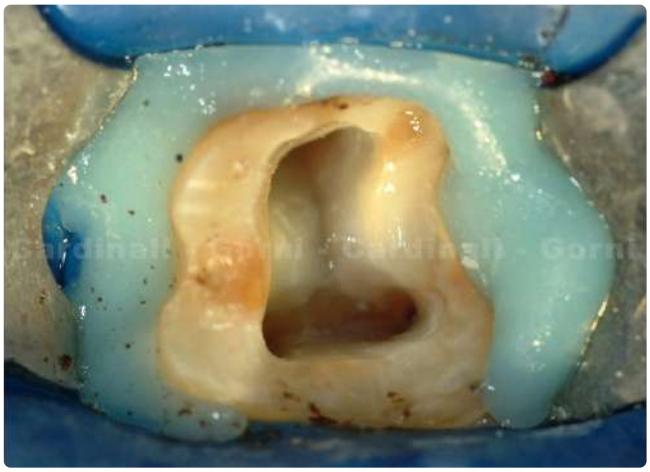


Fig. 3. Isolation goal is accomplished when operative field stability and leakage absence last for the whole treatment.

ISOLATION PLANNING

A comprehensive isolation planning is synonymous with:

- easy and correct dam placement
- a dam usage which is not detrimental to the treatment
- dam placement time reduction
- increased patient's compliance

Before starting the treatment, field isolation should be carefully planned in order to achieve a correct and comfortable dam placement and avoid rubber dam interference with subsequent operative manoeuvres.
Correct planning is also important to maximize isolation effectiveness with respect to the possible reduction of operative times.
The competent practitioner should place the dam in a few moments and with the utmost care: this will increase patient's compliance toward isolation techniques.
On the contrary, a meandering or unsteady placement, when clamps are continuously replaced due to lack of stability or the dam gets torn apart because the sheet is forced within narrow and edged contact points, will discourage practitioners from using this technique.
Correct planning stems from a thorough analysis of the area to be isolated in connection with the applicable dental treatment.
As a general rule, when it comes to a strictly endodontic or conservative occlusal treatment, isolation will affect a single element; on the other hand, if restorative treatment affects interproximal surfaces, then isolation will involve more teeth.

Before piercing the sheet, practitioner will detect any early difficulties through clinical examination and - should that be the case - perform suitable techniques and procedures to overcome them.
Careful planning is the only way to convert dam placement in a quick, easy and familiar procedure for every clinical scenario.

A rational and thoughtful operational sequence calls for a careful analysis of the following key factors:

1) DETERMINATION OF THE EXTENSION OF THE ISOLATION

2) CLAMP SELECTION

3) INSPECTION OF THE TARGET AREA - PROBLEMS INTERCEPTION

4) SHEET AND FRAME SELECTION

5) SHEET PIERCING

6) DAM PLACEMENT

7) RUBBER SHEET FITTING AND LEAKAGE CONTROL

By following these instructions carefully without skipping or leaving any step incomplete you will be able to swiftly approach every kind of isolation procedure.

Chapter 4

DETERMINATION OF THE EXTENSION OF THE ISOLATION

DETERMINATION OF THE EXTENSION OF THE ISOLATION

According to the treatment to be performed, practitioner should first determine the width of the operative area to be isolated and assess clamp position.

When it comes to Endodontics, one of the most frequently asked questions is about how many teeth must be included in the isolation.

It is evident that the more the teeth involved in the isolation the wider the access to the operative area.

During endodontic treatment, the operating maneuvers are carried out in the direction of the occlusal surface of the tooth where the access cavity is present (Fig 1).

When it comes to restorative treatment involving interproximal surfaces (I.e. class II restoration), the operating maneuvers are carried out not only in the direction of the occlusal surface, but even in the direction of the buccal and lingual/palatal surfaces (Fig 2).

So as a general rule, when it comes to a strictly endodontic, isolation will affect a single element; on the other hand, if the planned restorative treatment affects interproximal surfaces, then isolation will involve more teeth.

When it comes to carry out in a single visit the endodontic and restorative treatment in a tooth where an interproximal surface is involved, the operator will apply the rubber dam just one time and the isolation will involve multiple teeth (Fig. 3-10).

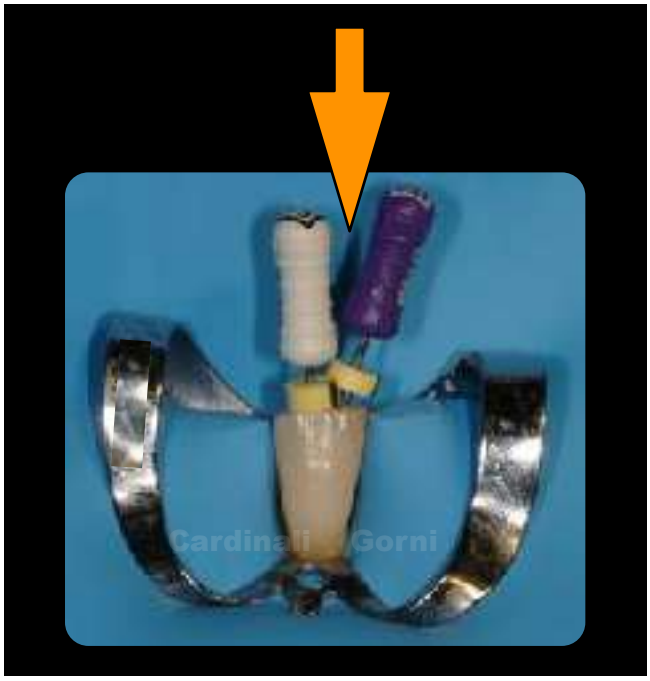


Fig. 1. Single tooth isolation for endodontic treatment

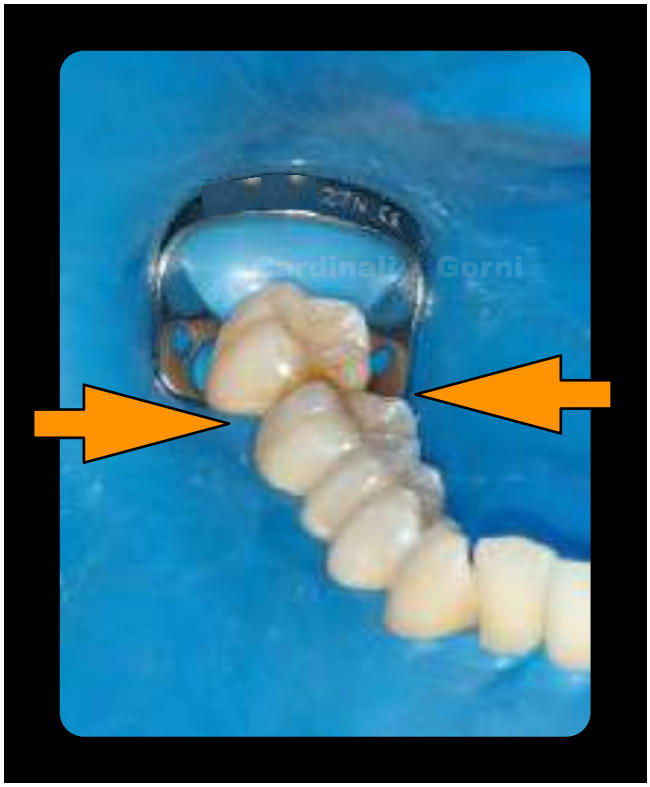


Fig. 2. Multiple isolation for restorative treatment involving an interproximal surface.

Fig. 3-7. Pulpitis on 4.7. A multiple isolation was carried out as Single-Visit for the Endodontic and Restorative treatment was scheduled.

Fig. 8-10. Post-operative, 1 year follow-up and 12 years follow-up radiographs of the case in Figs. 3-7.

Chapter 5

CLAMP SELECTION

CLAMP ROLE IN ISOLATION PROCEDURE

Regardless of dam placement technique or tooth characteristics, one of the most important steps in the operative isolation protocol is correct clamp selection.
Finding the right clamp is vital to achieve operative field stability for the whole duration of the treatment, whether it is endodontic or conservative.

FINDING THE RIGHT CLAMP:
- is the most important moment of the isolation procedure
- is essential to stabilize the operative field for the whole treatment duration
- is essential to make dam placement easier
- is strictly related to chosen treatment and target tooth

Clamps come in a wide range of patterns: winged, wingless, with knurled jaws, satin-finished and plastic (Fig 1).
Manufacturing companies usually divide clamps in three main groups: clamps for anterior teeth, for bicuspid teeth (premolars) and for molars (Fig. 2-4)
Approaching clamp selection by keeping on your desk all companies' samples just to randomly pick up a piece and see if it is the correct one is deeply irrational.
For a rapid and effective operative field isolation, the practitioner actually needs only a few tools and, first of all, he must know how the clamps work and which criteria have to be met in order to match a clamp with a specific tooth.

Fig. 1. Variety of clamps.

Fig. 2. Clamps for anterior teeth.

Fig. 3. Clamps for premolars teeth.

Fig. 4. Clamps for molars teeth.

The target tooth should be thoroughly checked in size, shape and position, as well as in relation to the periodontium and the nearby teeth.
Two dimensions are crucial: the vestibular-lingual and mesio-distal diameters.
Comparing these dimensions with certain clamp sizes will aid the practitioner in choosing the correct clamp.
As described in Chapter 2, the clamp is made of several parts: bracket, wings, holes, jaws and contact points (Fig 5).
When the clamp is at rest, the two dimensions to be carefully assessed are the distance between jaws and the distance between the mesial and distal contact points of each jaw (Fig. 6).
These values will be compared with the diameters of the tooth to be clamped (Fig. 7) and the chosen clamps will meet the following criteria:
-the distance between the two mesial and distal contact points (a) of each jaw must be lower than the tooth mesio-distal diameter (A).
-the distance between the two jaws (b) must be lower than the tooth vestibular-lingual diameter (B).

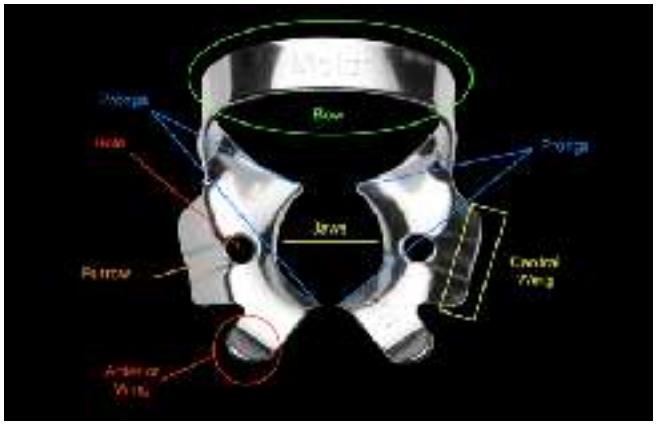


Fig. 15. The several parts forming Sanctuary clamp 201.

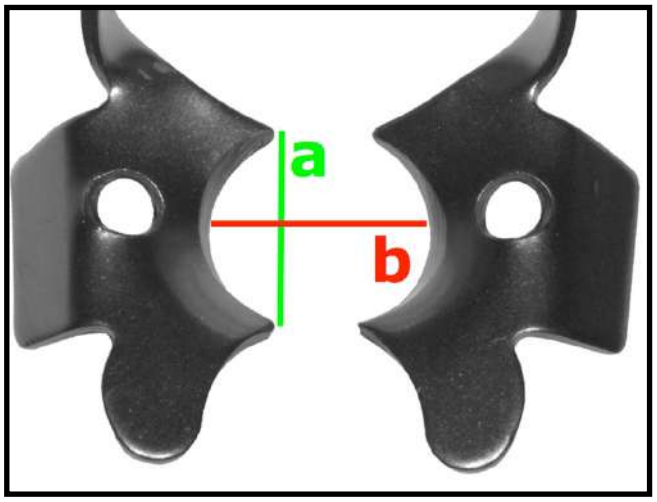


Fig. 6. Distance between mesial and distal contact points of each jaw (a) and jaw-to-jaw distance (b).

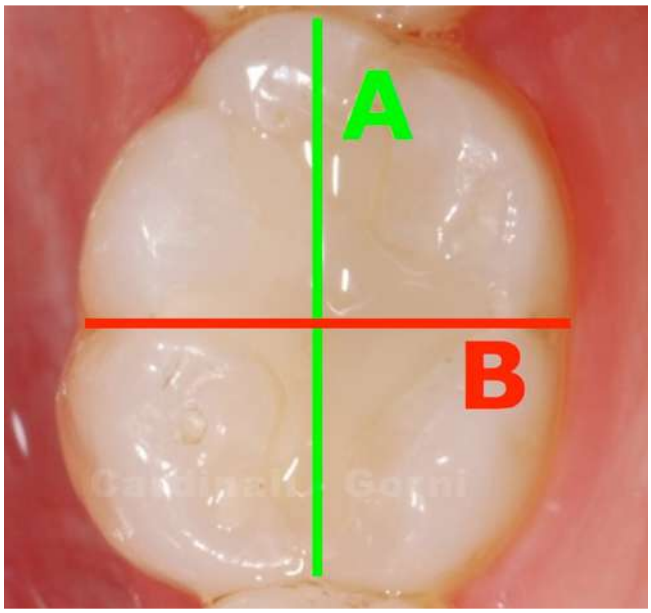


Fig. 7. Mesio-distal (A) and vestibular-lingual (B) tooth diameters.

HOW CLAMPS WORK AND THE RULE OF 4

A sound knowledge of how clamps work is very important to allow their correct selection and application. After bringing the clamp to the mouth with the dedicated plier, the practitioner will stretch the clamp jaws by pressing the plier handle, thus allowing the clamp to reach its final position and to overcome – if any – the clinical crown circumferance.

When the clamp is on, the practitioner can gently release the plier handle so the clamp can return to its rest position and the tooth structure experiences a gradual pressure without abrupt shocks.

When the clamp is disengaged from the plier, its jaws apply a pressure on the tooth by means of the bracket and this pressure is directly proportional to the jaw stretching. If the jaw-to-jaw distance of the resting clamp is similar to the vestibular-lingual diameter of the tooth, the clamp will only grip onto the tooth when it has returned to its rest position, thus resulting in poor stability.

Amongst clamp selection criteria, the practitioner should be familiar with the "rule of 4". Every clamp has 4 prongs or contact points (2 each jaw) to grip on the tooth. According to the "rule of 4", a clamp gripping on the tooth with all its four contact points at the same time is considered potentially stable and the pressure applied on the tooth is equally distributed on the 4 points, thus reducing the possibility of causing iatrogenic damages to the dental structure (Fig. 8).

The "rule of 4" is the main criteria for a fruitful clamp selection and only once we selected a clamp with the 4 prongs grabbing the tooth at the same time we could move to the next step that is the test to definitely asses if the clamp could be stable for the whole treatment duration or not.

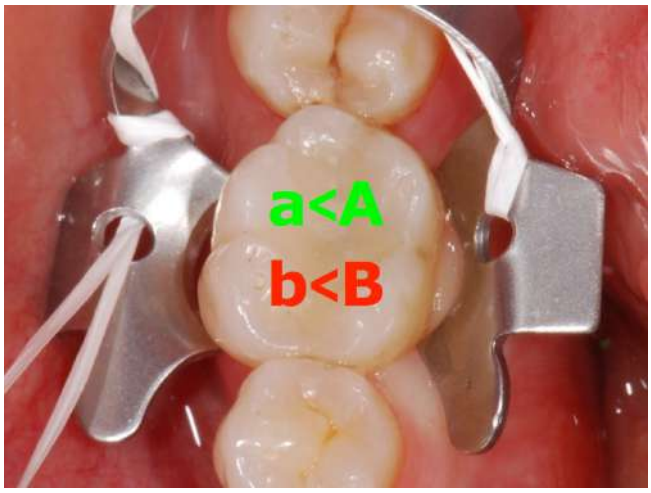


Fig. 8. The clamp is gripping on the tooth with all its 4 contact points simultaneously: the "rule of 4" is respected.

Only clinical examination can help the practitioner in making the right choice, which will not depend on commercial categories but on compliance with the requirements set forth above.

Endodontics clinical practice might call for using anterior clamps on premolars or molars, and premolar clamps on molars: the most important thing is to always comply with the "rule of 4" (Figs. 9-10): this often happens when it comes to endodontic treatment of prostethic abutment and/or teeth with a severely damaged crown for caries or fracture (Fig 11-17).

Fig. 9. On this maxillary premolar, a clamp for anterior teeth (212) is needed to restect the "rule of 4".

HOW CLAMPS WORK AND THE RULE OF 4

Fig. 10. In this small second maxillary molar, to respect the "rule of 4" a premolar clamo was used

Fig. 11. Anterior clamp 9 used to isolate the first maxyllary premolar stump.

Fig. 12. Anterior clamp 6 used to isolate the left lower molar stump.

Fig. 13. First maxillary premolar with a severely damaged crown by caries.

Fig. 14-17. An anterior clamp was used to respect the "rule of 4" and teflon and liquid dam to control the leakage.

OTHER CLAMP SELECTION CRITERIA IN ENDODONTICS

The "rule of 4" is the main criteria for a fruitful clamp selection in Endodontics and Restorative dentistry.

When it comes to Endodontics single tooth isolation, the clinician can apply other additional criteria for the selection of the most comfortable clamp for the treatment.

In single isolation procedures, for example, the Authors would like to recommend winged clamps so the sheet is more apically stretched around the tooth and the tooth itself is more visible and better highlighted (Fig. 18).

Amongst other criteria there is the importance of detecting an intact or damaged tooth clinical crown.

With an intact crown it is suitable to choose flat-jawed clamps (Fig. 19) since they are less traumatic to the periodontium.

On the contrary if the tooth's crown is damaged by caries or fractures or if it is a prosthetic stump, operative field stability is easier to achieve by using clamps with more aggressive jaws, capable of gripping the tooth at the gingival sulcus due to their angulation (Fig. 20).

In multi-rooted teeth, aggressive-jawed clamps are very effective since their tilt allows them to reach for the stump deeply and apically to the tooth preparation end line.

However, before using these clamps, the Authors always recommend to attempt to acheive stability through the use of less aggressive and flatter jaws such as the ones in clamp 4.

Fig. 18. Winged clamp 4 offers a clear view of the isolated tooth that is well exposed.

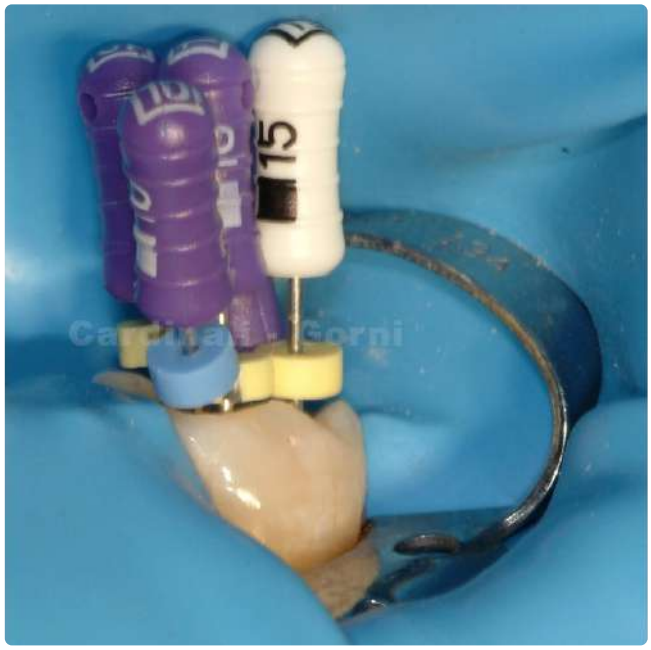


Fig. 19. The tooth shows an intact clinical crown so it is isolated with a flat-jawed clamp (13A).

The difference can be noticed in operative comfort: when a clamp has almost flat jaw like the 4, the tooth gets actually more exposed (and so more accessible) (Fig. 21-22). On the contrary, if isolation is performed using clamps with strongly tilted jaws, the tooth is going to look more "sunk" into operative field and less "approachable" by the practitioner (Fig. 23-24).

Fig. 20. The tooth shows a distally damaged clinical crown so it is isolated with a tilted-jawed clamp (8A).

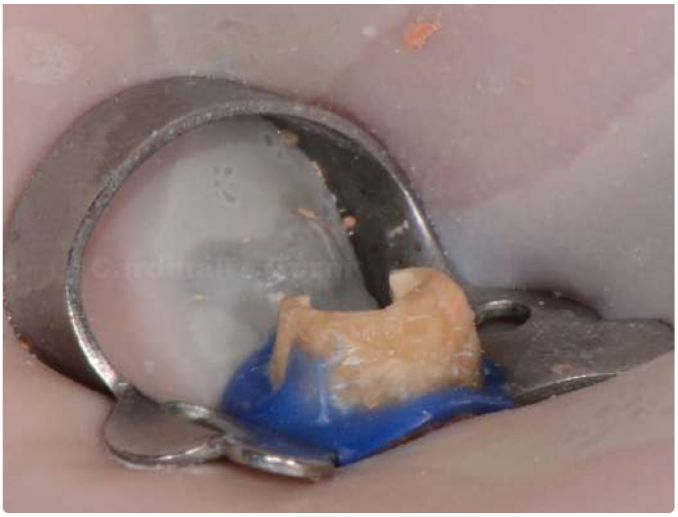


Fig. 21-22. Clamp 4 features not completely flat jaws; isolated stump of tooth 4.6 is well exposed and easily accessible to operative manoeuvres due to clamp 4 slightly tilted jaws.

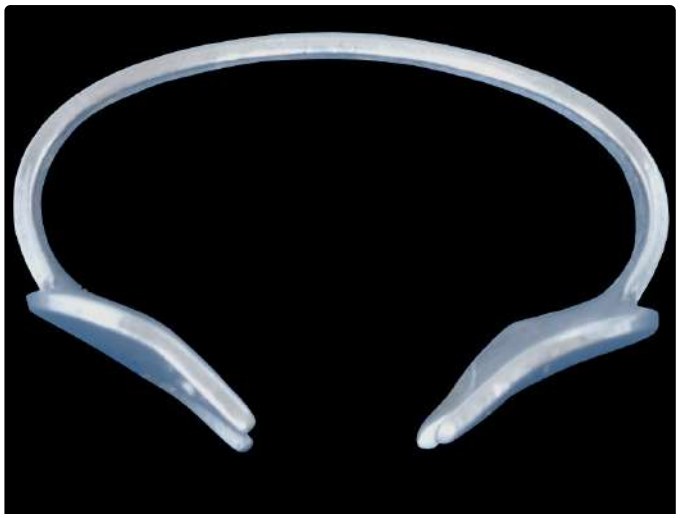


Fig. 23-24. Clamp 8A features very tilted, aggressive jaws. The same prosthetic stump of Fig. 21 isolated with clamp 8A: the tooth is more "sunk" into the operative field so it's harder to reach.

CLAMP STABILITY TEST

After picking up the clamp with the appropriate requirements (Fig. 24) and before applying the rubber sheet, the practitioner should clinically test the clamp stability.
When the tooth is clamped a couple of tests should be carried out.
The first one checks stability by applying an up-and-over oscillating pressure upon the jaws with your fingers (Fig. 25).
Secondly the practitioner puts his/her finger distally to the bracket and pulls in mesial direction, outward from the oral cavity (Fig. 26).
This is probably the most important test since the sheet, when stretched on the frame to retract soft tissues, will apply a strong displacing force upon the bracket for the whole treatment duration (Fig. 27-31).
Should this test be neglected, even if required features are met, while stretching the rubber sheet on the frame the clamp might be dislocated from the tooth.
This kind of mistake is typical of a clamp that, even abiding with the "rule of 4", clenches the tooth when already entering its rest position.
Stability test must be carried out safely to avoid the clamp being swallowed and/or inhaled by the patient in case of displacement: for this purpose, dental floss ligature is by far the better solution.
In clinical practice, when the isolation target tooth has an intact crown structure, the practitioner can perform the test without clamp ligatures by carefully putting the index of his/her non-dominant hand next to the bracket to prevent the clamp from being swallowed in case of instability.

Fig. 24. The chosen clamp meets the required features and it is ready for stability test.

Fig. 25. Stability test: up-and-over oscillating pressure on the jaws.

Fig. 26. Stability test: clamp bracket is pulled outward.

CLAMP STABILITY TEST

Fig. 27. The chosen clamp meets the required features and it is ready for stability test.

Fig. 28. Stability test: up-and-over oscillating pressure on the jaws.

Fig. 29. Stability test: clamp bracket is pulled outward.

Fig. 27. The anatomical model shows the dam dislocating thrust upon the bracket for the whole treatment duration.

Chapter 6

INSPECTION OF THE TARGET AREA: PROBLEMS INTERCEPTION

When the clamp has been chosen, it is necessary to test the accessibility to interproximal spaces - where the rubber sheet is going to be inserted – with the dental floss.
Despite being a simple task, this procedure is very important because, if contact points are so narrow to prevent dental floss from passing through or should the floss gets torn by jagged interproximal surfaces (especially in case of old tooth fillings), similarly the dam is going to get stuck or damaged. Such difficulties are no excuse for not using the dam.
Any obstacle should be properly assessed in terms of position and relevance, then it should be bypassed to place the dam.
In endodontics (and usually in single tooth isolations), any major obstacles preventing the dam from sliding into interproximal space is not a problem.
If an interference arises from the treated tooth and is caused – for example – by an old restoration needing to be removed, the operator can remove the interference with a separating bur, apply the dam easily and then remove the old restoration (Figs. 1-4).

Fig. 1. Interproximal interferences cause dental floss to break when passing.

Fig. 2. A separating bur can remove interferences within interproximal spaces.

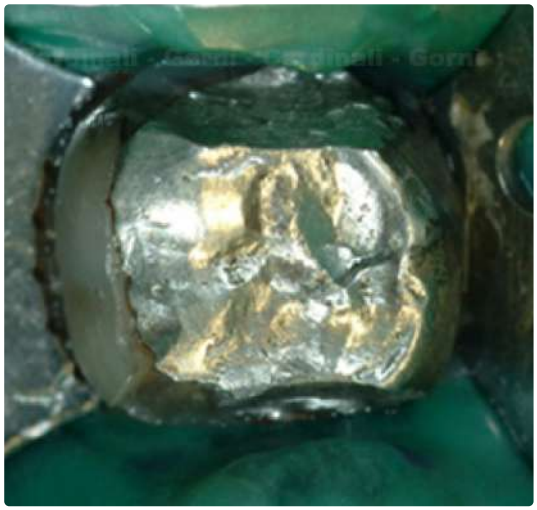


Fig. 3. When interferences are removed, the dam can be placed without tearing the sheet.

Fig. 4. Once the dam is placed, oral cavity is sheltered and the amalgam restoration can be removed.

On the contrary, if the interference is due to orthodontic splints or arches, gaps arising from a poorly fitting rubber sheet around the tooth are likely to cause saliva leakage: these gaps can be properly sealed using liquid dams (Figs. 5-9).

Once the leakage is controlled, the operator can access the root canal system for the therapy.

Fig. 7. Because of the splint there are wide gaps between operative field and oral cavity.

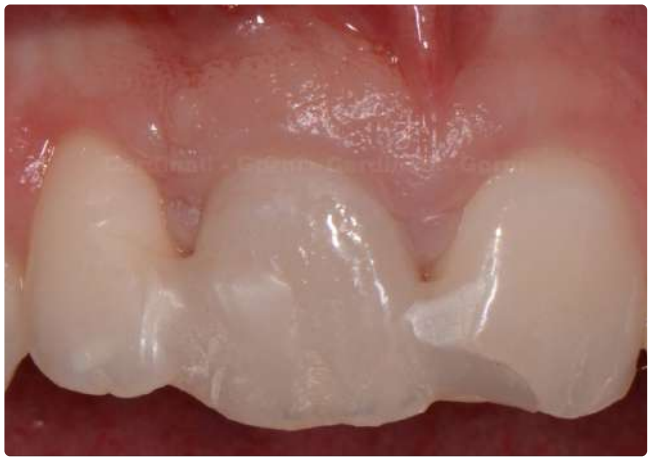


Fig. 5. Tooth 1.1 is necrotic and has been splinted with composite to reduce post-trauma mobility.

Fig. 8. Operative field seal can be easily achieved with the liquid dam.

Fig. 6. The splint prevents the dam from sliding into interproximal spaces.

Fig. 9. Once the leakage control is achieved thanks to the proper use of the liquid dam, it is possible to access the root canal system.

Chapter 7

SHEET & FRAME SELECTION

SHEET AND FRAME SELECTION

The practitioner chooses the type of rubber sheet and frame according to the treatment: conservative dentistry requires metal frame and a dark-colored dam to contrast restoration materials, while endodontics calls for a light-colored dam to make operative field brighter and a radio-transparent plastic frame to ease intraoperative radiograph.
Certainly it is possible to carry out a proper endodontic tretment using a dark-colored sheet and a metal frames.
The choice of the frame affects the way to take the intra-operative radiograph during the endodontic treatment.
The intraoperative radiograph is a crucial step of endodontic treatment and it should be completed using the easiest and most reliable and repeatable method. Among a few practitioners there is the perception that performing intra-operative radiograph with the dam placed is a difficult task.
Actually it is a very quick procedure: the problem is not the dam, but a poor knowledge of materials and techniques.
There are two common ways to perform intraoperative radiograph.
The first one is applied when metallic frame are used and it relies on endodontic centering devices: once landmarks (files, gutta-percha cones) are positioned into the root canals, the practitioner removes the rubber sheet from the frame and folds it to facilitate the positioning of the centering device with the film. This is the way to perform intraoperative radiograph with the paralleling technique (Figs. 1-3).

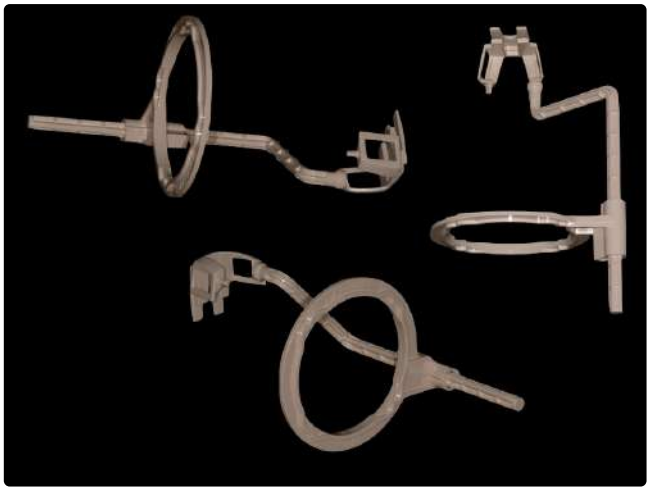


Fig. 1. RINN endodontic centering device to perform intraoperative radiographs.

Fig. 2. The endodontic centering device is placed after the dam is removed from the

Fig. 3. Intraoperative radiograph with file of the case in Fig. 2.

Secondly, the benefit of a radio-transparent frame allows the practitioner to perform the intraoperative radiograph without removing the dam. The Authors recommend this method since it is more time efficient and allows the rubber dam to be constantly maintained, thus achieving a stable and leakage-free operative field for the whole duration of treatment.
Removing and manipulating the rubber dam and frame whilst taking an intra-operative radiograph can cause a loss of stability and jeopardize operative field seal especially in complex cases. The possibility to perform intraoperative radiographs without removing the rubber sheet offers several advantages.
First of all the practitioner never loses sight of the root canal landmarks, so he/she knows that they are not moving.
If the dam is removed the sheet is folded over the landmarks to cover them; and when the patient is asked to close his/her mouth on the centering device, there is the risk that the landmarks or any endodontic materials within the tooth may become dislodged compared to their original position.
Using a radiotrasparent frame is a swift procedure involving only a slight learning curve. To be carried out it requires a Kelly or Pean surgical forceps and a radio-transparent plastic Nygaard-Ostby frame.
This octagonal-shaped frame is very comfortable for the patient especially when, after sheet is frame-mounted, excess rubber is cut with scissors. The radiograph film is clamped with the surgical forceps which act as a film-holder support (Fig.4,5), then it is brought to the mouth and placed parallel to the tooth to be radiographed (Figs. 6,7).

The forceps are not held by the patient: its position is maintained by the frame, clamping its handle by pressure on the patient's lips. At this point, the xray tube is positioned perpendicular to the film and tooth in accordance with the parallelling technique; the practitioner should align the tube parallel to the forceps handle(Fig. 8,9).
This procedure is recommended also for endodontic and conservative treatments involving interproximal surfaces in the same session. In such situations, when the dam is placed only once and multiple isolations are performed, to remove the dam from the quadrant in order to take an intraoperative radiograph would significantly increase the risk of field seal loss (Figs. 10-13).

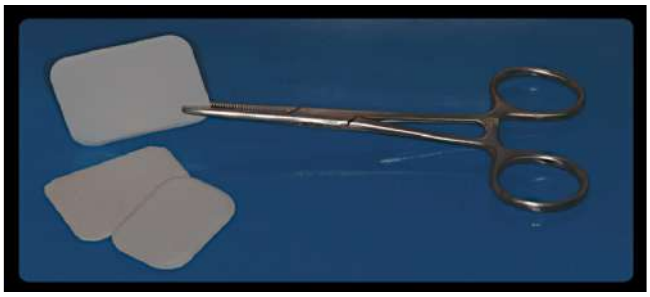


Fig. 4. The Kelly- or Pean surgical forceps acts like film-holder support.

Fig. 5. To protect a phosphor plate by the gripping action of the holder, it is possible to use the exceeding sheet removed after the application of the octagonal plastic frame.

Fig. 6. Nygaard-Ostby frame allows for intra-op radiographs without dam removal.

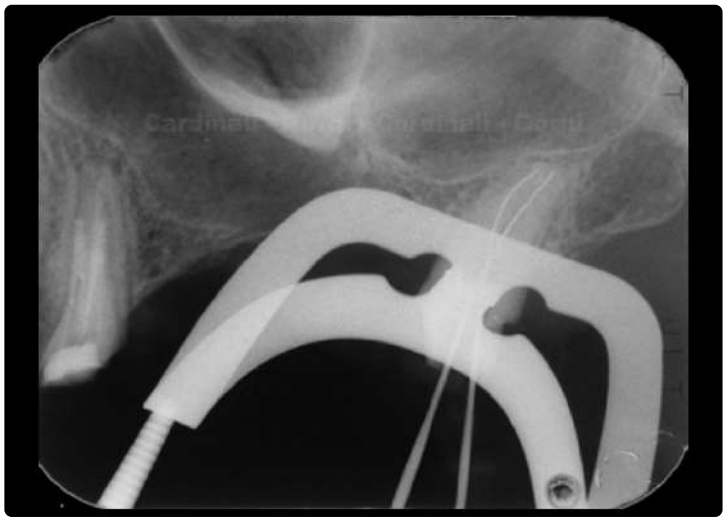


Fig. 7. Intra-operative radiograph of case in figure 4.

Fig. 8,9. Nygaard-Ostby frame allows for intra-op radiographs without dam removal in maxyllary and mandibular teeth.

Fig. 10-13. In case of multiple isolations due to endodontic and conservative treatment in the same session, leaving the frame is the only option to prevent avoids the risk of field seal loss.

Chapter 8

SHEET PIERCING

THE IMPORTANCE OF A CORRECT PIERCING

Piercing the rubber sheet is an important step to be performed with the utmost care since a wrong execution could affect leakage control, especially in multiple isolation procedures.
First of all, holes must be perfectly round. Holes are pierced when the punch plier core crushes the rubber sheet against the revolving head, thus obtaining a clean cut with the same size of the selected hole. This is the only way to achieve a perfectly round hole, which will make the sheet more resistant when it is stretched to pass through clamp and teeth. Should the hole be jagged, the practitioner is going to have two problems: firstly, the sheet will be less resistant to tearing (always starting from hole irregularities) during placement; secondly anything but a perfect circle will poorly fit to the tooth neck ruining the seal and predisposing to saliva leakages.

Fig. 1. In the Sanctuary Rubber Dam Punch the sizes of the holes are printed in the handle.

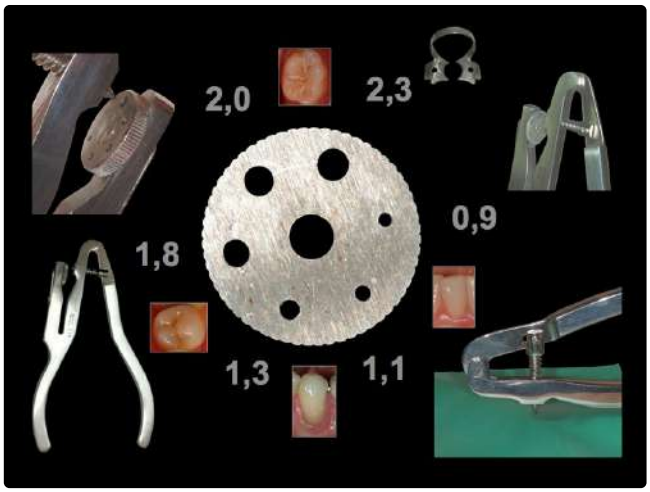


Fig. 2. Hole size and clinical indications on Ivory rubber dam punch plier.

HOLE SIZE

The size of the hole plays a lead role in building up a proper seal so it should not be overlooked.
If the hole is too small compared to the tooth diameter, the dam could be torn by an excessive tension during placement. On the contrary, when the hole is larger than the tooth it loses the ability to fit tightly to the tooth neck leading to saliva leakage.
Only after clinical examination during planning can the practitioner select the size according to actual tooth diameters.
As a general rule the Authors suggest to choose the bigger hole for the tooth to be clamped while gradually smaller diameters should be used to isolate molars, premolars, canines and incisors, as the case may be (Figs. 1-2).

According with this rule, when it comes to a single isolation for endodontic treatment, the Authors suggest to use the bigger size, even if the treatment is carried out in a mandibular incisor, because the use of the smaller size could result in the application of an high stress on the sheet, increasing the risk of tearing.
Experienced operators can select the size of the hole according with the application technique, as some techniques are less stresful for the sheet, but as a general rule, when it comes to single tooth isolation, the hole should be the bigger size available in the punch.

HOLE POSITION

There are many ways to reach a well-balanced and functional piercing.
Regardless of the implemented technique, the hole should be placed in such a position to have enough space between its rim and the sheet rim.
If the hole is too peripheral, the practitioner won't be able to stretch the dam over the frame or the dam will be pulled too hard and the seal lost.
The correct hole position can be determined by laying the sheet on the patient's face and pushing it with the finger against the teeth to be isolated: this will produce a moist stripe on the sheet surface corresponding to the piercing area (Fig. 3).
There is another procedure suggesting to lay the sheet on the occlusal table tagging with a marker the position of the teeth to be isolated (Fig. 4).
These techniques have one disadvantage: the punch plier must be sterilized after the piercing since it has been used on a sheet "contaminated" with saliva.
Should the practitioner be provided with study models of the patient, the sheet can be laid on the model and the teeth to be isolated can be tagged on it with a marker.
One more strategy to put the holes in the right place is to rely on a template, which is a cardboard gauge to be laid on the sheet in order to accurately felt-tip mark the dam hole position (Fig. 5,6).

Fig. 3. The moist stripe resulting on the sheet can guide the practitioner during piercing.

Fig. 4. With the sheet laid down on the face it is possible to felt-tip mark the teeth to be isolated.

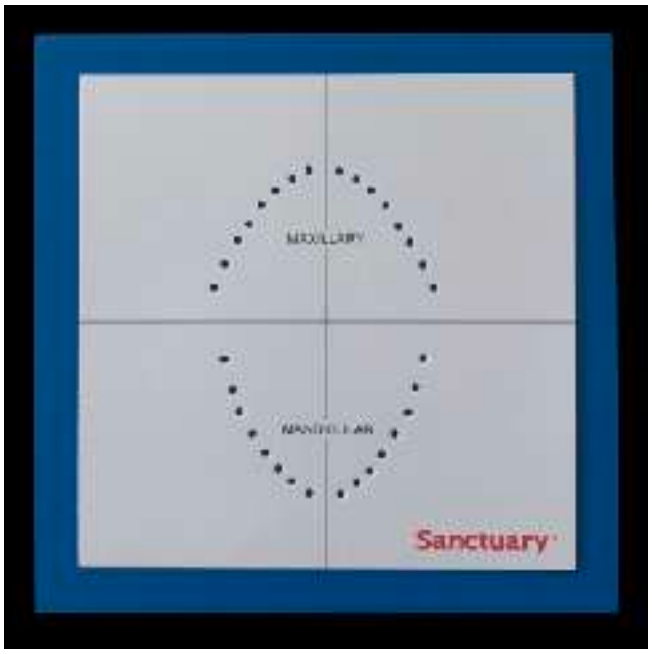


Fig. 5. Template from Sanctuary

HOLE POSITION

The stamp offers a very similar advantage, allowing you to print on the rubber sheet a number of points corresponding to teeth average positions (Fig. 7).
Template and stamp should be positioned so that the points indicating the upper central incisors' position are placed at about 2.5 cm from the sheet upper rim: in this case, when the dam is on, it will be more comfortable for the patient since the sheet upper rim will find itself slightly under the nose without covering it.
The skilled practitioner usually performs a freehand piercing after carefully inspecting the operative field (Fig. 8).

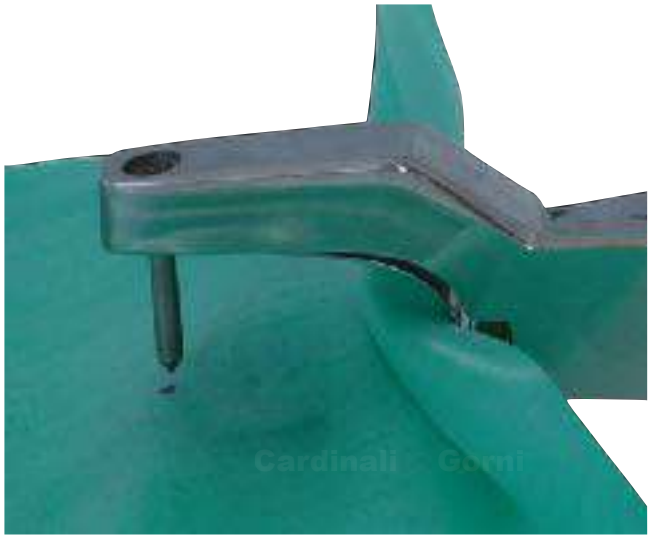


Fig. 6. An hole position felt-tip marked by the template eases the piercing of the sheet in the right position.

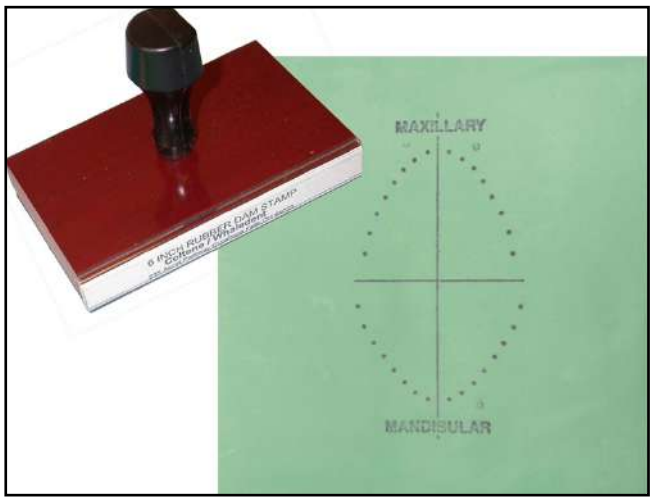


Fig. 7. Rubber Dam Stamp

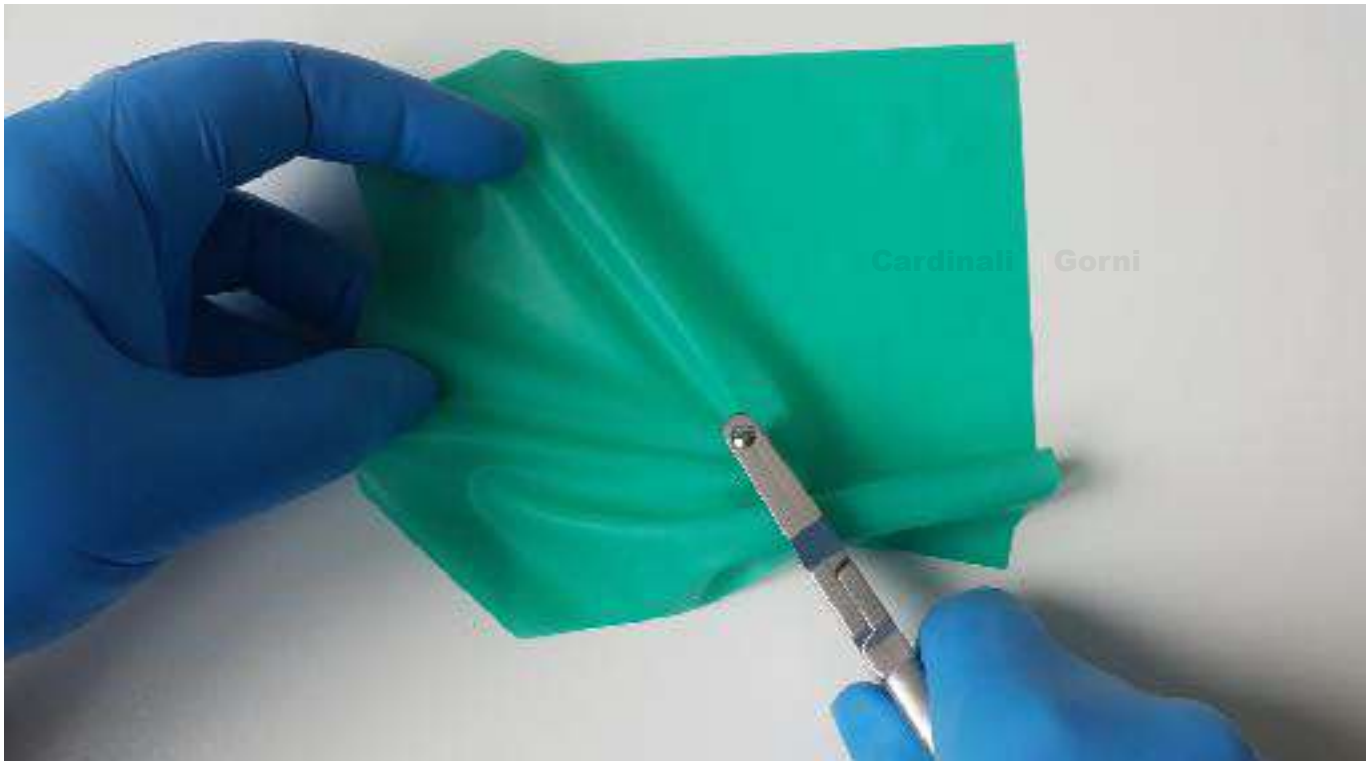


Fig. 8. Freehand piercing of the sheet.

Chapter 9

THE DAM: APPLICATION TECHNIQUES

THE IMPORTANCE OF BEING FAMILIAR WITH ALL PLACEMENT TECHNIQUES

A swift and gentle dam placement is only possible if any obstacle has been detected and bypassed, and it is essential to increase patient's compliance toward this treatment.

There are four main placement techniques described in literature, they share the same basic concepts – clamp stability and correct hole positioning – and they all lead to the same outcome (Figs. 1-3).

It is no wonder that every practitioner has his/her own favorite technique; nevertheless, each one of them has its own pros and cons to be carefully assessed within the clinical situation.

In everyday practice, for example, there are situations where operative field stability can be ensured only by clamps foreseeing "rubber-first" technique implementation, while in other cases the wing technique is the one leading to a correct dam placement without any problems.

It is therefore necessary, or should we better say mandatory, to have a deep and thorough understanding of the four techniques.

Fig. 1. A stable clamp together with a pierced sheet is the common starting point for the application of the dam, regardless the technique used.

Fig. 2. Tooth after dam placement (regardless of the implemented technique).

Fig. 3. Tooth after dam placement (regardless of the implemented technique).

TECHNIQUE

The target tooth is first clamped, then the dam is inserted by stretching the rubber around the bracket and subsequently around the branches until tooth neck is entirely covered (Figs. 4-8).

Fig. 4. Target tooth clamped by Sanctuary clamp 202.

Fig. 5. The procedure begins by sliding the dam through the clamp bracket.

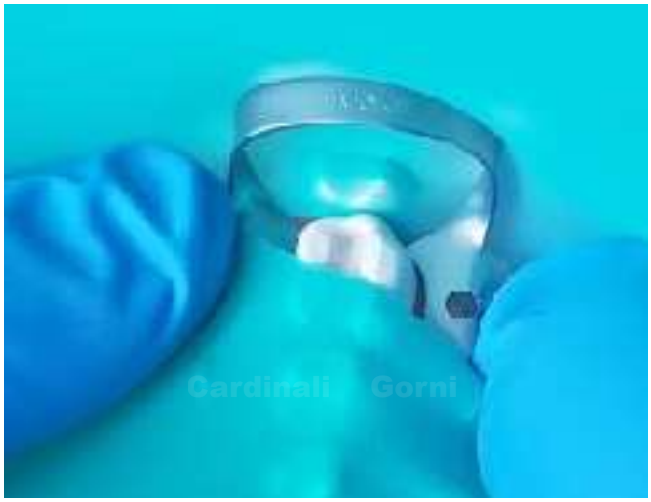


Fig. 6. The dam is slid under the vestibular branch.

Fig. 7. The dam is slid under the lingual branch.

Fig. 8. Tooth after dam placement

CLAMP FIRST TECHNIQUE

ADVANTAGES

The "clamp-first" technique is a two-handed procedure so it doesn't need any assistance. Its biggest benefit is the excellent operative field visibility during placement. It can be implemented only with single-bracket (premolars-molars) and preferably wingless clamps.

DISADVANTAGES

Should the clamp unfasten during placement, the risk of swallowing and/or inhaling it is surely higher than with other techniques. Furthermore, to avoid any kind of displacement the practitioner should choose a stable clamp since it is meant to undergo a severe strain during sheet placement.
For these reasons the clamp should be fastened with a ligature.
This technique cannot be implemented with double-bracket clamps (for anterior teeth) and the risk of sheet tearing is higher when using winged clamps since they are bigger and require a wider hole stretching compared to wingless clamps.
For the same reason this procedure cannot be implemented with latex-free dams since the extreme hole stretching required causes the sheet structure to inevitably collapse (Figs. 9-10).

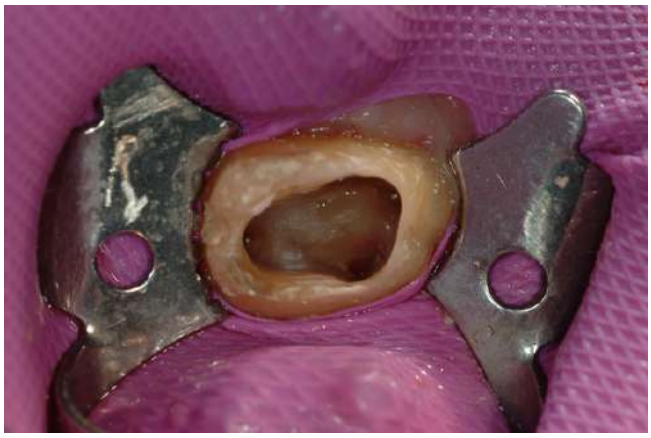


Fig. 9. The extreme hole stretching during "clamp-first" technique causes the latex-free dam structure to collapse.

Fig. 10. The post-collapse gap is sealed with cellulose foam.

CLINICAL CONSIDERATIONS

This technique is very comfortable because once the clamp stability test is done and the right clamp has been chosen, the practitioner can leave it on the tooth and proceed with rubber sheet placement.
However, the clamp should never be left unattended inside the mouth if it is not secured with a dental floss ligature.

CLAMP FIRST TECHNIQUE

CLINICAL CASE

Application of the dam on 4.6 using the Clamp First Technique (Fig. 11-15).

Fig. 11. Tooth clamping

Fig. 12. The procedure begins by sliding the dam through the clamp bracket.

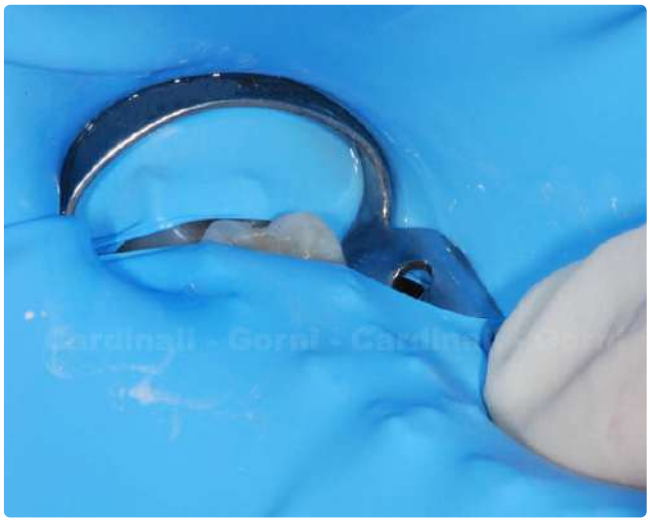


Fig. 13. The dam is slid under the lingual branch.

Fig. 14. The dam is slid under the buccal branch.

Fig. 15. Tooth after dam placement

WING TECHNIQUE

This very common procedure calls for the simultaneous placement of clamp and rubber sheet: it takes its name from the clamp, which is engaged and held within the sheet hole by means of the central wings (Fig. 16).
After the sheet has been properly stretched over the wings by means of the dedicated plier, the clamp is "armed" and placement can be performed; the frame can be mounted simultaneously with the rubber sheet or later.
With a little spatula or any other non-cutting tool, the rubber dam is slid from the wings to the tooth neck (Figs. 17-23).

Fig. 16. The Sanctuary clamp 202 is engaged and held within the hole by the wings.

Fig. 17. The sheet is slightly stretched over the frame.

Fig. 18. The clamp is "armed" with the forceps.

Fig. 19. Clamp and sheet are placed on the target tooth.

WING TECHNIQUE

ADVANTAGES

The wing technique is a two-handed procedure so it doesn't need any assistance.
Moreover it is safe because, should the clamp unfasten from the plier during placement, still it would be engaged on the rubber sheet hole without risks of being swallowed and/or inhaled by the patient. Dam placement is very quick and the patient does not feel the oral cavity invaded by practitioner's hands.

DISADVANTAGES

Using winged clamps is a necessary condition of this technique. The main issue lies in limited tooth visibility during clamping.
The practitioner can only see the tooth through the hole the clamp is engaged to.
If the tooth is not well recognizable, an inexperienced practitioner could clamp the adjacent tooth by mistake.

CLINICAL CONSIDERATIONS

Wing procedure is very quick and minimally invasive. For this reason it should be considered the most suitable technique for patients with a strong emetic reflex or who seem baffled by dam usage. Limited visibility inherent to this technique can cause the clamping of the wrong tooth especially if the target tooth does not have any distinguishing features. A tipo solve this issue is"marking" the tooth by creating with the turbine a slight cavity to be subsequently completed after dam placement.

Fig. 21. Thanks to the furrow in the wing of the Sanctuary clamp 202, there is a space between the wing and the sheet that can be easily engaged by the spatula to promoting the sliding of the sheet under the jaw

Fig. 22. With a little spatula the rubber dam is "disengaged" from the lingual wing and slid around the tooth neck. The furrow present in the wing of Sanctuary clamp eases a lot this action.

Fig. 20. With a little spatula the rubber dam is "disengaged" from the buccal wing. The furrow in the wing of the Sanctuary clamp 202 eases the penetration of the spatula between the sheet and the clamp's wing.

Fig. 23. Clamp and sheet are placed on the target tooth.

CLINICAL CASE

Application of the dam on 4.6 using the Wing Technique (Fig. 24-28).

Fig. 24. The already selected clamp is engaged and held within the hole by the wings.

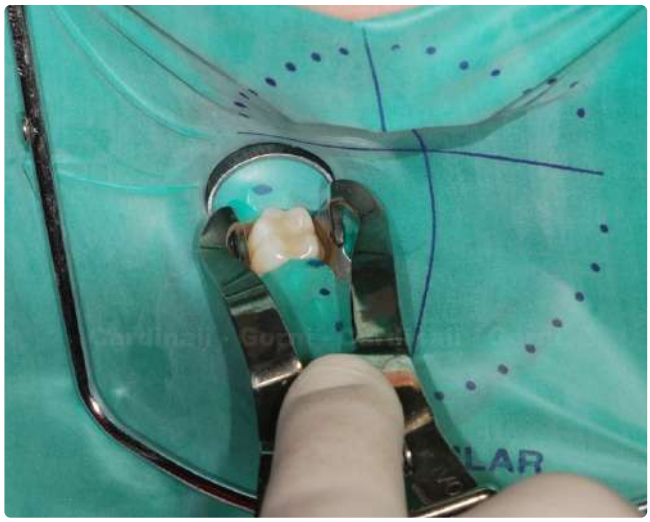


Fig. 25. The clamp is placed on the tooth after being "armed" with the dedicated plier.

Fig. 26. With a little spatula the rubber dam is "disengaged" from the lingual wing and slid around the tooth neck.

Fig. 27. With a little spatula the rubber dam is "disengaged" from the vestibular wing and slid around the tooth neck.

Fig. 28. Tooth after dam placement.

RUBBER FIRST TECHNIQUE

TECHNIQUE

This is a four-handed procedure thus the presence of a second operator is needed.

One operator, generally the assistant, stretches the hole with his/her fingers and places the dam directly into the oral cavity by fitting the tooth through the open gap. Now the dentist can clench the tooth with the previously "armed" clamp from the dedicated plier (Figs. 29-32).

Fig. 29. The Assistant identifies the tooth to be isolated.

Fig. 30. The assistant places the dam by fitting the tooth through the rubber sheet hole.

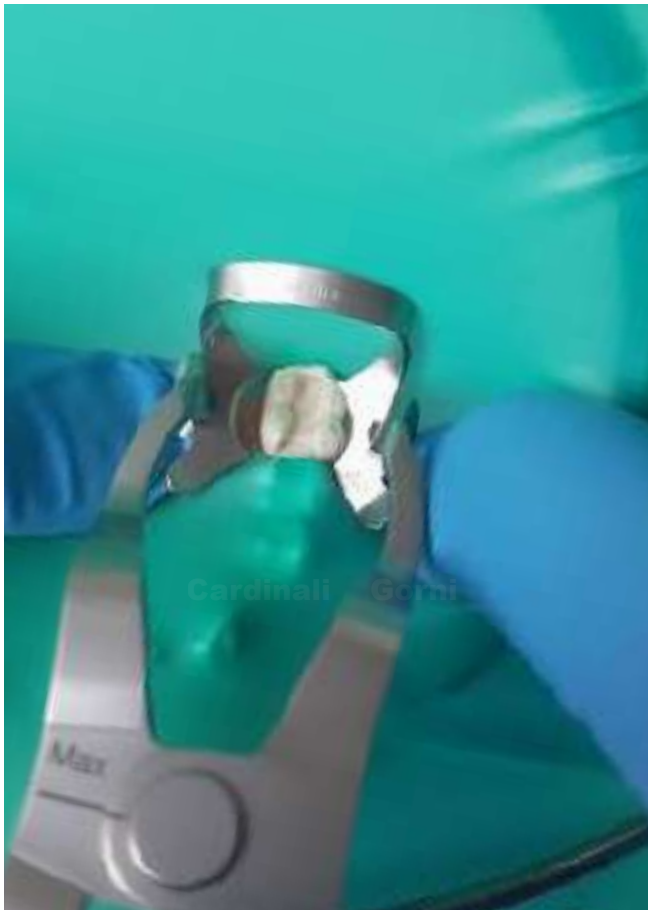


Fig. 31. The practitioner clamps the tooth.

Fig. 32. Tooth after dam placement

CLINICAL CASE

Application of the dam on 4.6 using the Rubber First Technique (Fig. 24-28).

Fig. 33. The assistant identifies the tooth to be isolated.

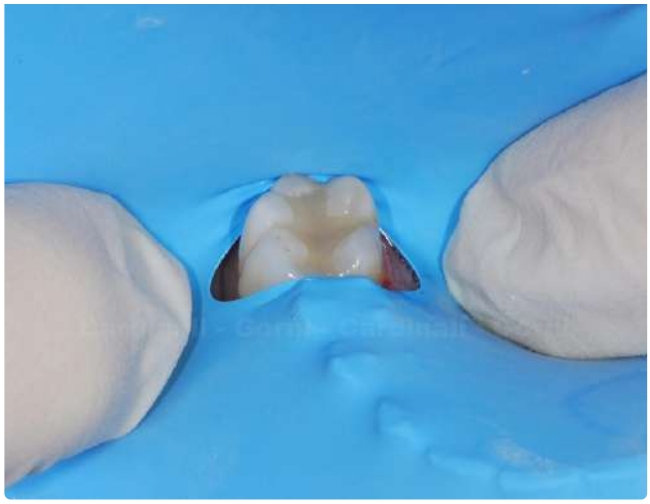


Fig. 34. An operator places the dam by fitting the tooth through the rubber sheet hole.

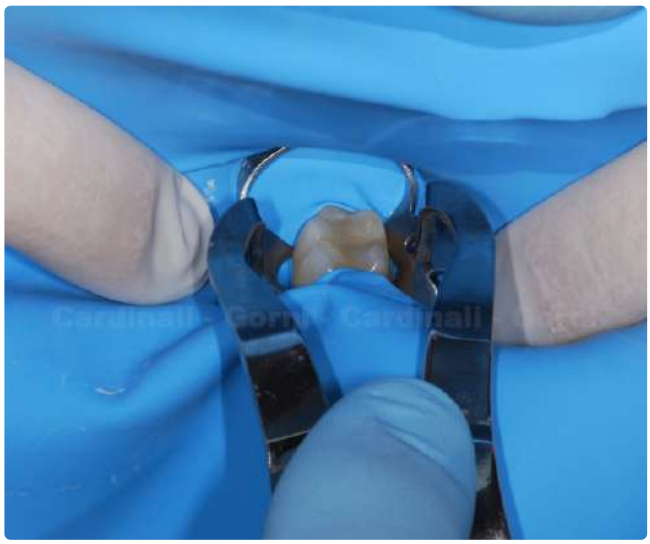


Fig. 35. The second operator clamps the tooth.

Fig. 36. The Rubber First Technique is a four hands procedure: position of the operators.

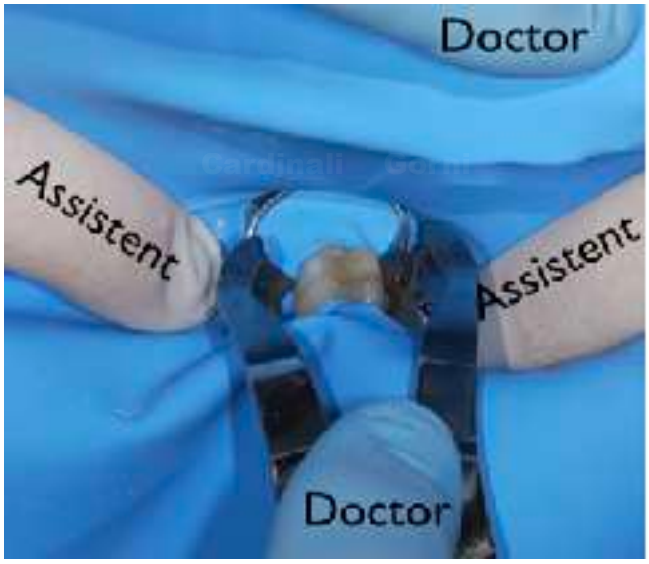


Fig. 37. The Assistant places the dam and the Doctor clamps the tooth.

Fig. 38. Tooth after dam placement

RUBBER FIRST TECHNIQUE

ADVANTAGES

The "rubber-first" technique is quick and safe: if the clamp gets somehow disengaged from the plier it falls on the rubber sheet without being swallowed and/or inhaled by the patient.

Besides being suitable for every type of clamp, this is the top procedure when using double-bracket wingless clamps such as the 212 or 90N.

On top of that this is the ultimate technique also with latex-free dams.

DISADVANTAGES

The first issue is limited visibility of the target tooth during placement, and the second disadvantage is patient discomfort due to the invasive action of the assistant's hands, who should maintain the sheet low around the tooth neck whilst waiting for the dentist to place the clamp.

CLINICAL CONSIDERATIONS

Identifying the tooth to be fitted into the hole under conditions of limited visibility and performing a proper clamping without damages to surrounding soft tissues are two crucial steps never to be committed to the assistant.

"Rubber-first" technique can therefore be modified to solve this issue.

The practitioner stands beside the patient holding in his/her dominant hand the plier already armed with a clamp while taking the rubber sheet and bringing his/her index finger at the hole level with the other hand.

The assistant puts the index finger of one hand at the other side of the hole while holding the upper corners of the sheet with the other hand to prevent it from bending and obstructing the view during the procedure. In this way the dentist can "guide" the assistant toward the target tooth before clamping it (Figs. 39.40).

Fig. 39. The practitioner stands beside the patient holding in his/her dominant hand the plier already armed with a clamp while taking the rubber sheet and bringing his/her index finger at the hole level with the other hand. The assistant puts the index finger of one hand at the other side of the hole while holding the upper corners of the sheet with the other hand to prevent it from bending and obstructing the view during the procedure.

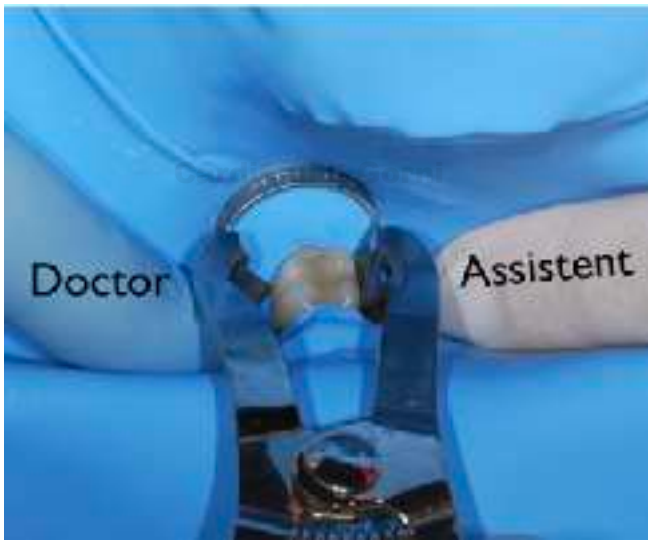


Fig. 40. The practitioner (blue gloves) supports the assistant (white gloves) in spotting the target tooth, then he/she can clamp it. In this way the dentist can "guide" the assistant toward the target tooth before clamping it.

TECHNIQUE

In this procedure the clamp and the rubber sheet are simultaneously positioned on the tooth. It takes its name from the clamp being engaged and held within the sheet hole by the bracket.

The bracket is passed through the hole until it comes out from the sheet side facing the practitioner. With the dominant hand, the practitioner "arms" the clamp by means of the plier, while the other hand laterally folds and gathers the rubber sheet.

The clamp-dam-plier unit shape reminds of a person strapped to a parachute (that's why the bracket technique is also known as the "parachute" technique).

When the tooth is clamped, the dam is stretched over the frame then it is manually slid beneath both clamp branches (Figs. 41-49).

Fig. 41. The bracket is passed through the hole.

Fig. 42. The hole in the corner of the sheet will help the clinician to properly strech the sheet over the frame.

Fig. 43. The practitioner "arms" the clamp by means of the plier, while the other hand laterally folds and gathers the rubber sheet.

Fig. 44. Excellent target tooth visibility during clamping.

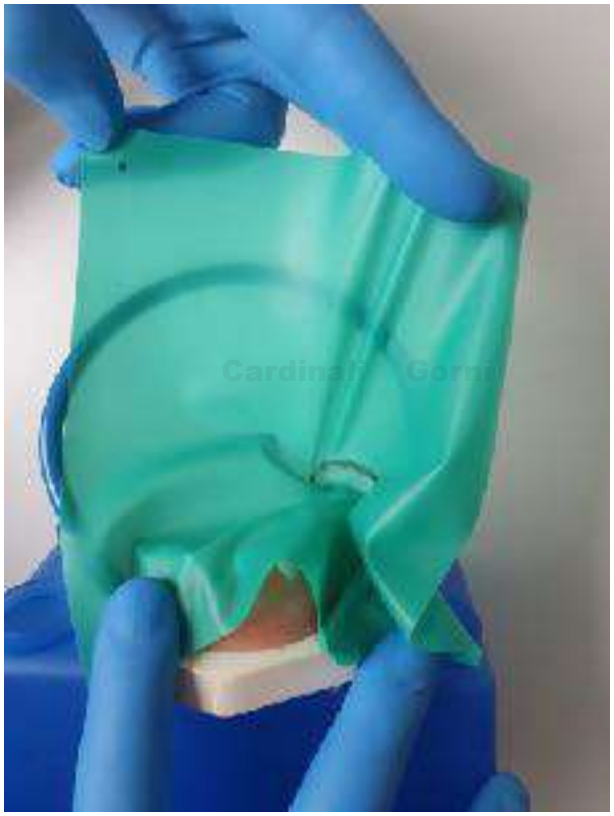


Fig. 45. The hole in the corner allows the clinician to open the sheet in the proper position.

Fig. 46. The clinician stretches the sheet over the frame.

Fig. 47. After stretching the dam over the frame, the rubber sheet is slid under the vestibular branch.

Fig. 48. The rubber sheet is slid under the lingual branch.

Fig. 49. Tooth after dam placement

BRACKET TECHNIQUE

ADVANTAGES

This is a two-handed procedure so it doesn't need any assistance. Moreover it is a safe technique because, should the clamp get disengaged from the plier during placement, still it remains engaged on the rubber sheet hole without the risk of being swallowed and/or inhaled by the patient. Oral cavity visibility is excellent so it is very easy for the practitioner to identify the tooth to be clamped.

DISADVANTAGES

Wingless clamps are recommended. Winged clamps - same design but bigger – would force the practitioner to apply a strong tension on the sheet to make it slide under the wings, therefore placement would be not so easy and the risk of tearing the sheet would be higher.
This procedure cannot be implemented with double-bracket anterior teeth clamps.Regardless of the clamp, we do not recommend to use this procedure with latex-free dams because the excessive twisting of the sheet while sliding under the branches causes the sheet structure to collapse.

CLINICAL CONSIDERATIONS

This technique allows the placement of the sheet and clamp together under optimal viewing conditions.
The bracket technique is also a desired technique when the clamp must be placed on the second or third lower molars and the bracket is clearly pressing the mucosae covering the mandibular ramus during clamp testing, or when the clamp must be placed on the second upper molars and the bracket is clearly pressing the mucosae covering the zygomatic process of the upper jaw bone during clamp testing.

CLINICAL CASE

Application of the dam on 4.6 using the Bracket Technique (Fig. 50-56).

Fig. 50. The bracket is passed through the hole pierced on the sheet.

Fig. 51. Once the clamp is "armed" by means of the plier, while the other hand laterally folds and gathers the rubber sheet.

Fig. 52. Practitioner's dominant hand "arms" the clamp with the dedicated plier while the other hand laterally folds and gathers the rubber sheet.

Fig. 53. Excellent field visibility during clamping.

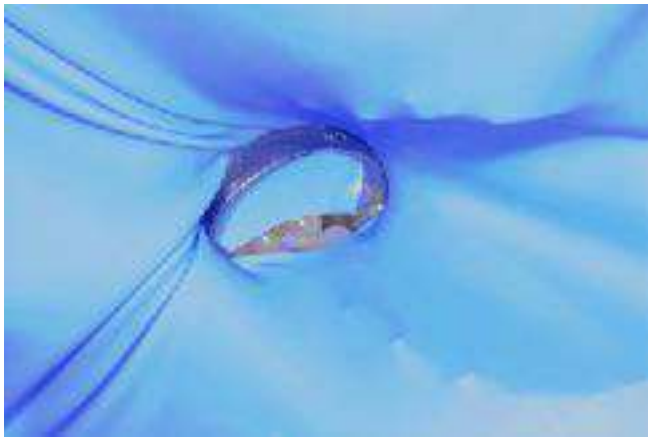


Fig. 54. Situation once the dam is stretched over the frame.

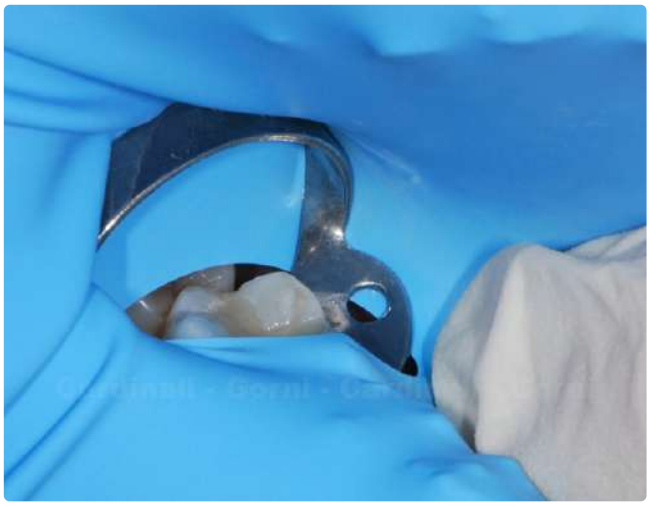


Fig. 55. The rubber sheet is slid under the lingual branch.

Fig. 56. The rubber sheet is slid under the vestibular branch.

Chapter 10

RUBBER SHEET FITTING
&
LEAKAGE CONTROL

RUBBER SHEET FITTING

Regardless of the technique, once the dam has been applied the practitioner must slide the sheet through the mesial and distal interproximal spaces of the clamped tooth to get a proper fitting that will result in a good leakage control.
This is ensured if accessibility of interdental spaces has been floss-tested beforehand.
By means of dental floss the practitioner will insert the dam within the inter-proximal space until the sheet has completely passed the contact point
This manoeuvre is quite simple at mesial level (Fig. 1) and more difficult at distal level since dental floss must pass behind clamp bracket to work properly (Figs. 2,3).
For double bracket clamps it is often necessary to use the floss after passing it behind both brackets.

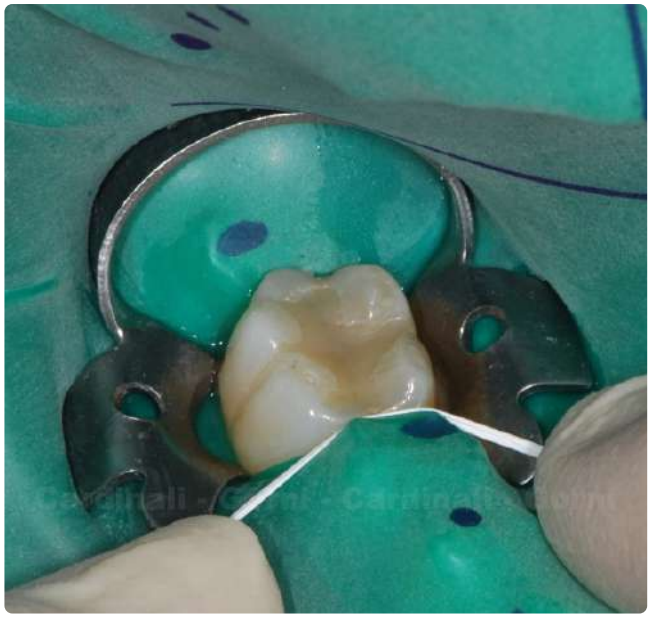


Fig. 1. Dam insertion in mesial interproximal space of the clamped tooth.

Fig. 2. To slide the dam into distal interproximal space the floss must pass behind the bracket.

Fig. 3. Only by positioning the floss behind the bracket can the dam slide easily into distal interproximal space.

LEAKAGE CONTROL

Even though the dam is correctly placed and slided through the interproximal surfaces, there still could be a poor fitting of the clamp-dam system to the tooth shape in the cervical area.
As a result of this ineffective seal we can notice the presence of saliva and/or blood in the operative field and irrigation fluids or root canal exudates leaking from field to oral cavity: this often happens when it comes to isolation of complex cases as prosthetic abutment or teeth with the crown severely damaged by caries or fracture.
Hard-to-isolate teeth are no excuse for avoiding the rubber dam: the more difficult the tooth, the more the dentist will appreciate the advantages of using the dam.
Nevertheless, it is of key importance to appreciate that once the field is isolated, the clinical case will be transformed from complex to simple with noticeable benefits for the operative procedures to follow.
If the clamp is stable, the presence of these gaps is no sufficient reason to search for another, better-fitting clamp. In clinical practice gaps can be managed with special materials providing us with a perfect seal.
There are products currently available for sale called *liquid dams*: they are easy-to-use light curing flowable resins capable of sealing quickly and effectively any gaps causing fluid leakage from and to oral cavity.
The liquid dam extension should not be restricted solely to covering the defect, but it should also include a tooth portion and the part of the sheet close to the gap: this is the only way for the liquid dam to create a proper seal for the whole treatment duration (Figs. 4-6).
Should one of these sealing products be missing, a fluid composite (flow) can be used without acid-etching nor dentin-enamel adhesive (Figs. 7-9).

Fig. 4. The clamp and the dam are applied correctly but still there is a gap allowing for liquid leakage from and to the oral cavity.

Fig. 5. To obtain a complete seal the liquid dam should be applied even on tooth, rubber sheet and clamp.

Fig. 6. A correctly applied liquid dam ensures leakage control for the whole treatment duration.

Fig. 7. Presence of a gap allowing for liquid leakage from and to the oral cavity.

Fig. 8. The gap is sealed with flowable composite without acid-etching nor dentin-enamel adhesive.

Fig. 9. The flowable composite ensures leakage control for the whole treatment duration.

The liquid dam together with a proper clamp selection is really important every time the clinician has to carry out a difficult retreatment as part of a multidisciplinary treatment plan that includes the periodontal surgery. In cases like this, one of the most common doubt is if it worth to try to recover the tooth or if it is better to replace the tooth with an implant.

In these cases the best option for the patient is to perform endodontic treatment before periodontal surgery in order to assess as timely as possible the chances of endodontic success. In such complex cases, the practitioner should know techniques and rationale for operative field isolation.

The main issue will be finding a clamp to ensure enough field stability.

The common method would be to reach the tooth at a deeper level using clamps with more aggressive jaws designed to move the gingival margin (Figs. 10-21).

In many of these situations an effective stability can be achieved by using anterior teeth clamps (6-9-212) on posterior teeth (premolars-molars).

Their small size and the presence of a double bracket create a greater pressure on the remaining dental structure (Figs. 22-30).

Fig. 10-11. Pre-operative radiograph and clinical situation of 4.6: the tooth presents a severely damaged crown and the treatment plan includes the periodontal surgery.

LEAKAGE CONTROL

Fig. 12. A clamp with tilted jaws (8A) ensures the stability of the operative field, the liquid dam ensures the leakage control.

Fig. 13. The proper use of the materials allows the clinician to assess as timely as possible the chances of endodontic success.

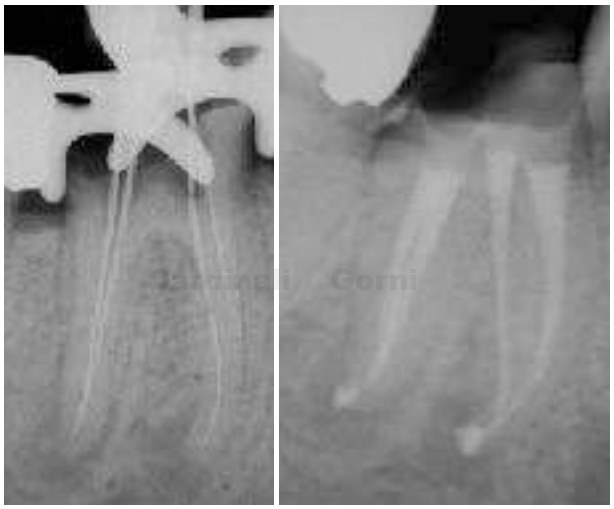


Fig. 14, 15. The ledge in the ML lingual canal was managed properly and a 3d obturation was carried out.

Fig. 16, 17. Post-operative radiograph and clinical situation at the end of the endodontic treatment: orifices were sealed with flow.

Fig. 18, 19. Clinical situation after the surgery and radiograph after restoration.

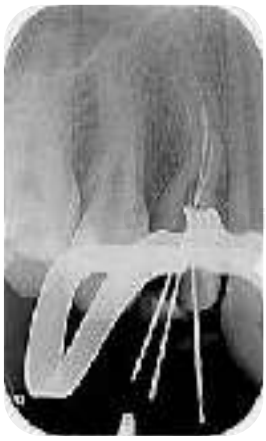
Fig. 20, 21. Follow-up after 1 and 9 years the end of the treatment.

LEAKAGE CONTROL

Fig. 22-23. Pre-operative radiograph and clinical situation of tooth 1.4: the tooth presents a severely damaged crown.

Fig. 24. Clamp 212 moves away the gingival margin and deeply reaches the remaining vestibular dental structure.

Fig. 25. Leakage control is achieved by means of the liquid dam.



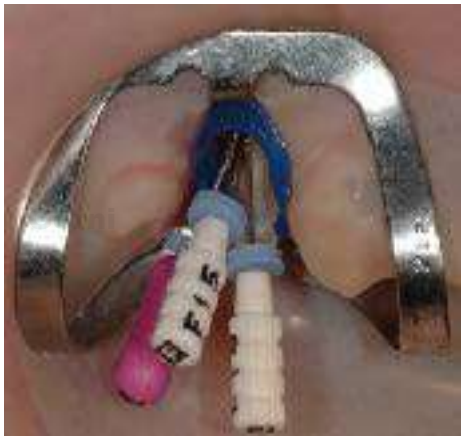


Fig. 26,27. Intra-op radiograph with the 3 files at WL.

Fig. 28-30. Intra-op. radiograph with cones at WL before the obturation; after the obturation, orifices are sealed with flow. Post-operative radiograph after obturation.

Chapter 11

OPERATIVE TIMING IN ENDODONTICS: WHEN TO APPLY THE RUBBER DAM

WHEN TO APPLY THE RUBBER DAM IN ENDODONTICS

Once the key role of the dam in the infection control is understood, it is clear that the dam should always be placed before accessing the endodontic space in order to avoid its contamination by oral cavity microorganisms.
If the dam application technique involves bad field visibility during clamping ("wing" and/or "rubber first" procedure), it could be useful to sketch the access cavity before isolating the operative field.
This is a double-benefit procedure: first, the tooth is marked so it's easier to spot while clamping; then anesthesia effect is tested (it is difficult to further administer anesthesia once the field is isolated (Figs. 1-6).

Fig. 1. Pre-operative situation of the tooth 1.4.

Fig. 2. By sketching the acces cavity, the tooth to be endodontically treated is "marked" so it can be distinguished from the adjacent tooth.

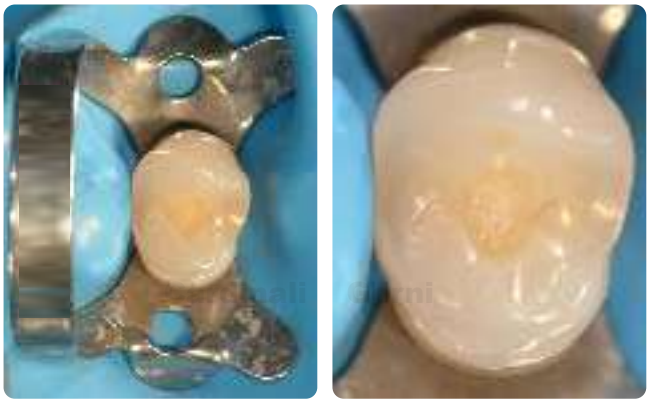


Fig. 3, 4. As the tooth is marked, it's easier to spot while clamping.

Fig. 5, 6. Endodontic space can be accessed after operative field isolation.

If the target tooth is irregularly angled or rotated the practitioner should be very careful in opening the pulp chamber because once operative field is isolated there is no more spatial relation between the tooth, its adjacent elements and the periodontal structures, thus increasing the risk of perforations.
Obviously the risk of causing iatrogenic damage is inversely proportional to the practitioner's endodontic skill and anatomy background knowledge.
In cases like this, rather than to risk to create a iatrogenic damage, it is better discovering a pulp horn before applying the dam: as soon as there is no more risk of perforation, the dam is placed and the operator can safely continue the endodontic treatment (Figs. 7-11).

Fig. 8-10. The strong tilt angle of tooth 3.5 can be less appreciated after operative field is isolated (even with a light-colored dam).

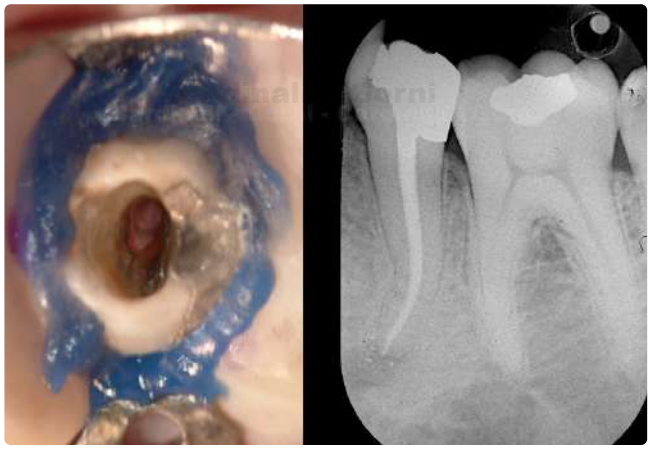


Fig. 11,12. Clinical and radiographic image of the completed case.

When the loss of crown structure is caused by deep interproximal caries, before isolating the field the practitioner must remove the decayed tissue at interproximal level obviously without accessing the endodontic space (Figs. 13-15). The creation of a clear cervical tooth surface before field isolation is needed to assess the necessity for any clinical crown lengthening surgery and to avoid tearing of the sheet caused by the bur during caries removal at that level.
When the dam is on, leakage control is achieved and endodontic space is accessed; besides easing endodontic treatment manoeuvres, the absence of mesial wall makes root canal access easier for rotary instrumentation (Figs. 16-19).

Fig. 13,14. Tooth 4.6 shows a severe loss of sane crown structure due to a big penetrating caries at mesial interproximal level.

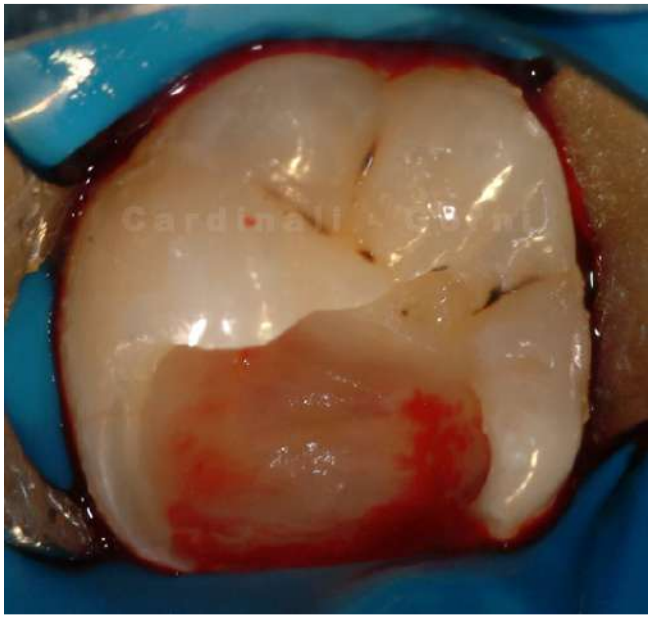


Fig. 15. Operative field is isolated only when the caries has been removed from the mesial cervical step and before accessing the endodontic space.

Fig. 16. Endodontic space is accessed after achieving leakage control by using a liquid dam.

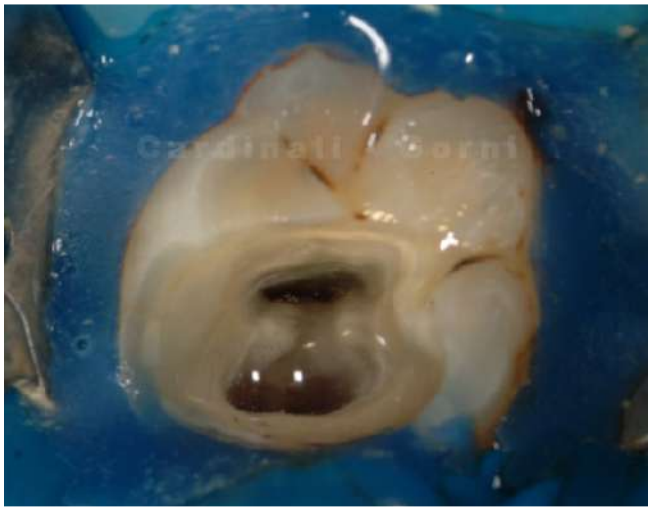


Fig. 17. Operative field view after shaping and radicular canal cleansing.

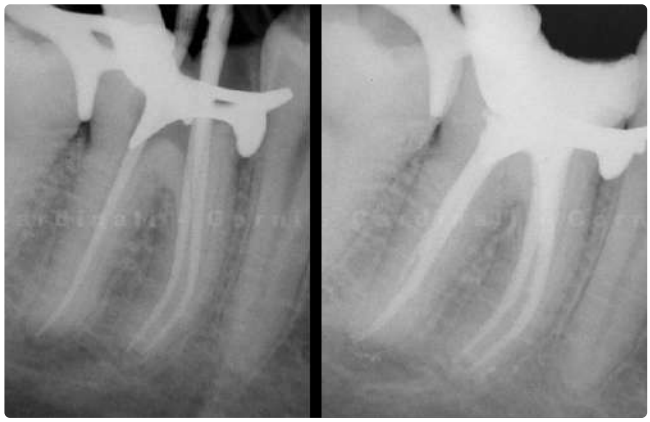


Fig. 18,19. Intraoperative and post-root canal obturation radiograph.

If necessary, in some cases it could be useful to remove the marginal gum covering the tooth so as to expose the hard tissue and make it "vulnerable" to the clamp (Figs. 20-23).

After choosing a stable clamp, the dam can be placed: in these situations it is quite normal for the rubber sheet not to fit properly around the tooth. Once the leakage is controlled it is possible to access the root canal system (Figs. 24-28).

Fig. 20,21. Tooth 3.7 needs endodontic treatment and the occlusal access is covered by a great amount of gingival tissue.

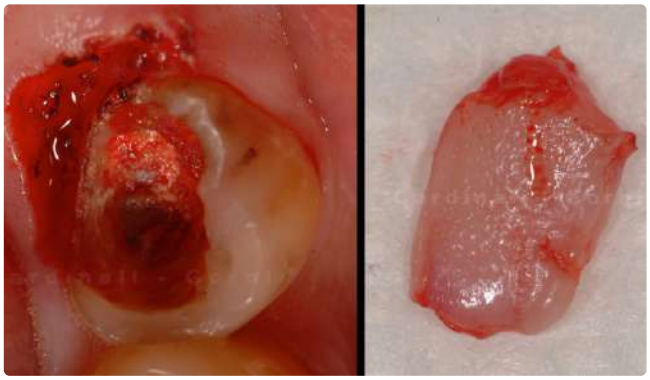


Fig. 22,23. Excess gingival tissue covering the tooth is removed with an electro-scalpel.

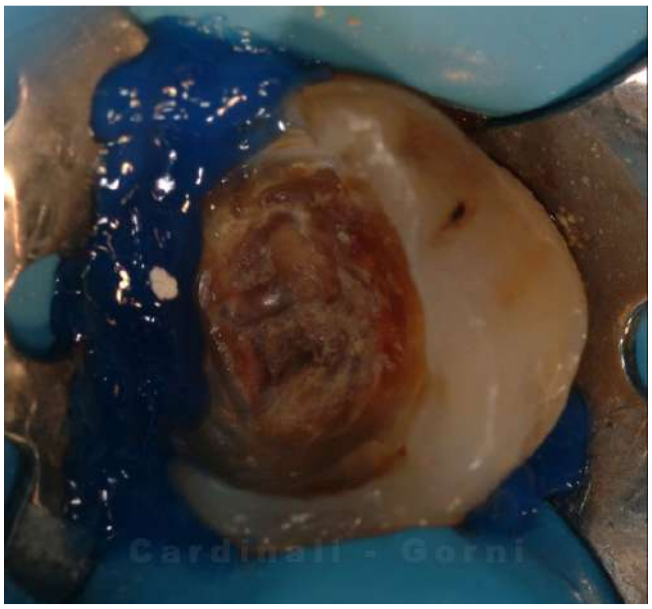


Fig. 24. Leakage control is achieved by using a liquid dam.

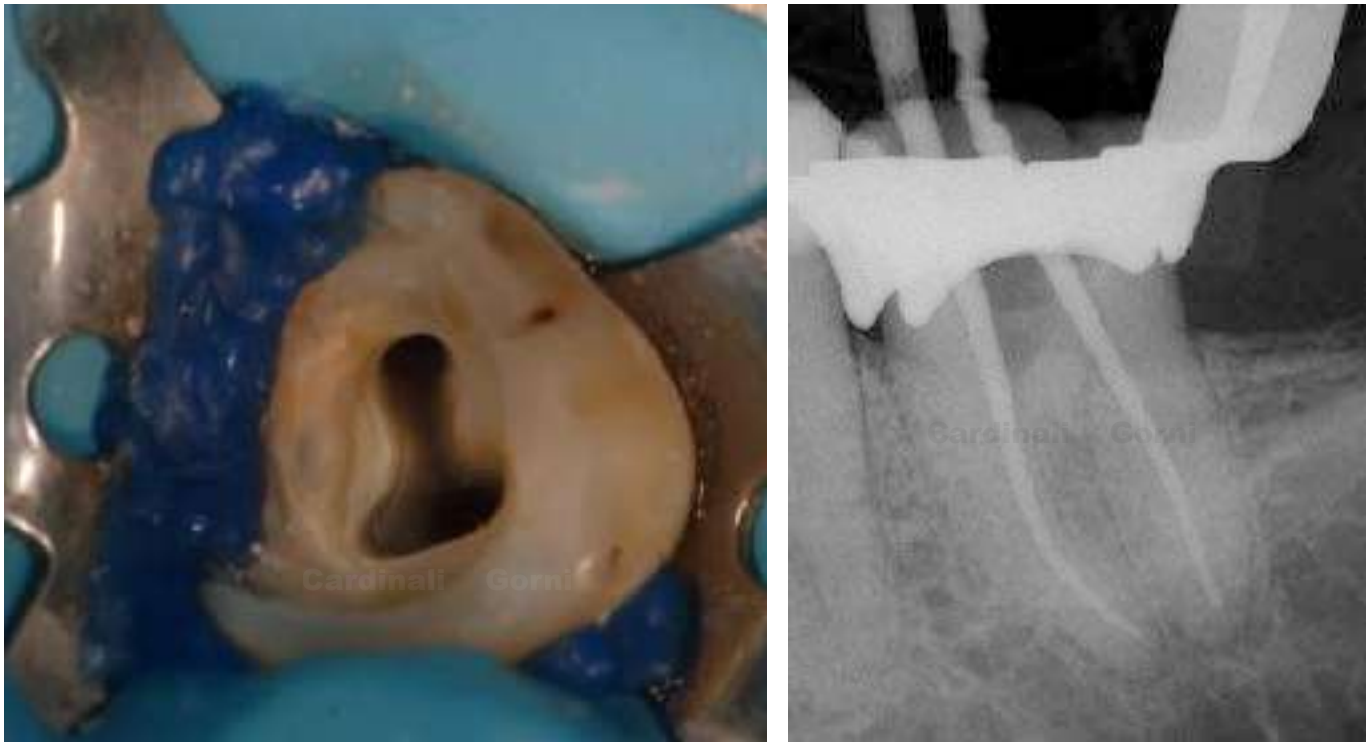


Fig. 25,26. Endodontic space access is performed after dam placement and leakage control; cones fit intraoperative radiograph before obturation.

Fig. 27,28. Follow-up radiography after endodontic and restorative treatment and 5 years after treatment finalization with composite indirect restoration.

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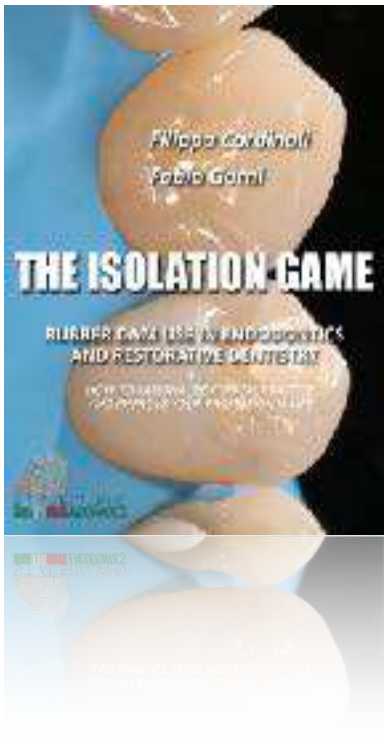

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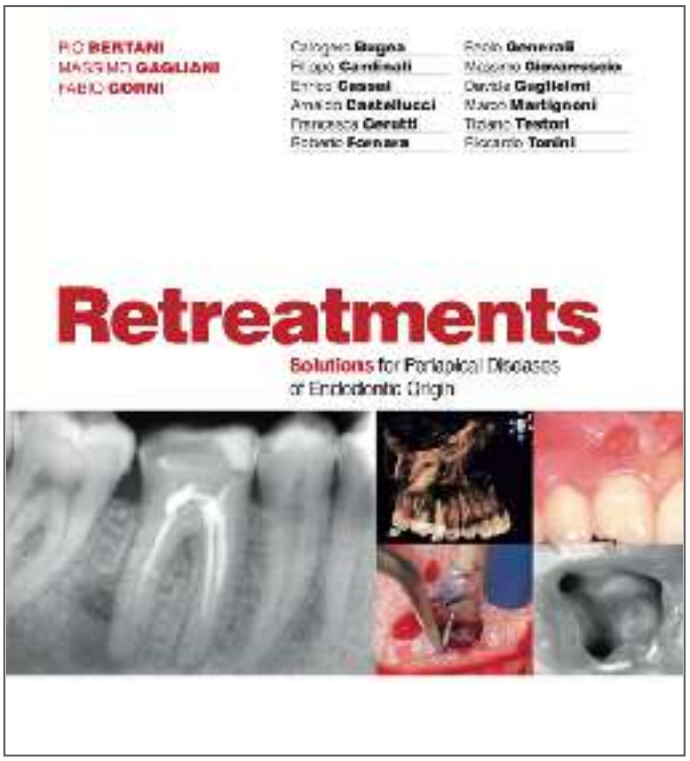

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