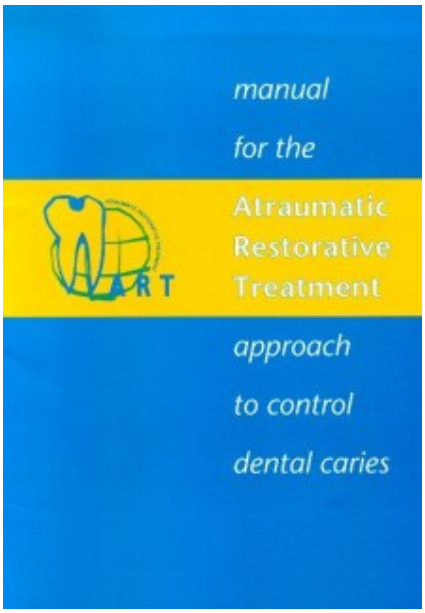
MANUAL FOR THE ATRAUMATIC RESTAURATIVE TREATMENT APPROACH TO CONTROL DENTAL CARIES



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Introduction

The Atraumatic Restorative Treatment (ART) is a procedure based on removing carious tooth tissues using hand instruments alone and restoring the cavity with an adhesive restorative material. At present the restorative material is glass-ionomer. This procedure has been developed because millions of people in less-industrialized countries and certain special groups such as refugees and people living in deprived communities are unable to obtain restorative dental care. Their teeth gradually decay until extraction is the only treatment option. These people have not benefited from the developments that have brought about improved oral health and care in the industrialized world. The absence of electricity and the idea that restorative dental care always requires special electrically driven equipment are the main reasons for this situation. In contrast, the ART approach enables treatment of cavities in teeth to be provided for people residing in areas where electricity is not available or, alternatively, in areas which have electricity, but where the community cannot afford expensive dental equipment.

Glass-ionomers are very useful dental restorative materials. In addition to its use as a restorative material, glass-ionomers can be applied in the very early stages of caries development. The glass-ionomer sticks to the tooth and halts or slows the progression of lesions, mainly because it slowly releases fluoride.

ART is, however, just one component of oral health care which must start with health promoting messages about a prudent diet and good oral hygiene using a fluoride containing toothpaste. Sealing pits and grooves in the chewing surfaces of teeth is another preventive action to consider. Removing carious tooth tissue with hand instruments alone, and restoring the cavity with an adhesive material - that is ART - will conserve as much tooth structure as possible and prevent further decay. This approach is a breakthrough towards achieving the goal that all people should retain as many teeth as possible: "Teeth for life".

ART provides care for decayed teeth, which is non-threatening, low cost, and can prevent extractions in most cases.

Oral care workers are now able to carry all the necessary equipment, instruments and materials for providing oral care in a handbag, and travel easily by bus or bicycle. In addition, they will also be able to educate people about good and bad oral health habits and healthy behaviour. Oral health care workers in the field who make use of ART will appreciate the very positive advantages that this approach offers for saving teeth from decay. This will provide them with greater job satisfaction and communities will be better motivated towards oral health.

Furthermore, in the industrialized world, there are also many applications where ART is appropriate. ART is based on modern knowledge about minimal intervention, minimal invasion and minimal cavity preparation for carious lesions. Because it is such a friendly procedure, there are great potentials for its use in children as well as in fearful adults. It also provides a restorative option for special groups in the community, such as the physically or mentally handicapped, people living in nursing homes and the home-bound elderly. Atraumatic Restorative Treatment was pioneered in the mid 1980s in Tanzania. In 1991, a community field trial started in Thailand, comparing ART with traditional treatment using portable dental drilling equipment and amalgam. Based on the experiences gained in Thailand, another community field trial was set up in Zimbabwe in 1993. The results of the latter study has shown that through the careful application of ART, about 85% of one-surface restorations in the permanent dentition will be in a good to acceptable condition after 3 years. The studies in Thailand and Zimbabwe, and also another community field trial, which started in 1995 in Pakistan, have clearly shown that pain is rarely experienced with this approach. In fact, if applied correctly ART is well received by the vast majority of patients.

In conclusion, ART is quality treatment applicable to all communities.

The results of the longitudinal studies and the practical experience gained in applying ART over the last five years have convinced us of the need for a revised edition of the ART Manual. This new manual contains instructions for the treatment of caries in both the early stage and when it has progressed into a cavity. It is principally meant for those who have limited experience in oral care procedures. A number of chapters will be very useful for qualified dental workers. However, the manual is not a self-instruction guide. Rather, those people who intend to use ART are advised to follow an ART training course first before using the approach in the field and clinic. This manual will assist them both in the training course and later in the field and clinic.

We must emphasize that ART should be considered as part of a total package of oral health care that is based on a philosophy of promoting health and preventing diseases.

The authors would like to acknowledge the support from Mrs. Jennifer Sardo-Infirri from the World Health Organization, Geneva, Dr. Christopher J. Holmgren from the University of Hong Kong and Dr. Graham Mount from the University of Adelaide, Australia for their valuable comments, encouragement and editorial advice. The support of Dr. Waranuch Pithipat (who was one of the authors of the earlier editions of this Manual) and colleagues of Khon Kaen University in Thailand, as well as of the Ministry of Health & Child Welfare in Zimbabwe, is acknowledge and greatly appreciated.
Harare, January 1997

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Chapter 1 - Mouth, teeth and dental caries

This chapter presents a brief description of the mouth, the teeth and dental caries, the disease that causes tooth decay and cavities in teeth. It provides the basic knowledge needed for using the Atraumatic Restorative Treatment of dental caries described in the following chapters.

The Mouth

With our mouth and teeth we are able to talk, to smile, to express emotions and to enjoy eating. The lips are the entrance to the oral cavity. The oral cavity is bordered by the lips, the cheeks, the floor of the mouth and the tongue, and by the soft and hard palate, also called the roof of the mouth.
The inside of the oral cavity is covered by a slippery mucous membrane. That is because there is always saliva in the mouth. Saliva contains substances that help digestion. It also contains minerals and proteins that protect the teeth. We produce a lot of saliva when we chew coarse foods. We produce only a little saliva when we sleep. As the flow of saliva needs to be controlled when carrying out restorative procedures in the mouth, it is useful to know where it comes from:

Through little openings in the mucous membrane of the cheek, close to the left and right upper molars
through openings in the floor of the mouth, just behind the lower front teeth.

The tongue has a very important function, that of taste. It enables us to tell the difference between sweet, salty, sour and bitter foods. When we eat, the tongue, lips and cheeks place pieces of food between the teeth so they can be chewed and mixed with saliva. They can then be swallowed and digested. The tongue is a very active muscle. When giving oral treatment such as ART, you often need to control the tongue, so that the treatment area remains dry.

The Teeth

The teeth are arranged in two arches in the upper and lower jaws. They are surrounded by the lips, cheeks and tongue. Each tooth consists of a crown and a root, which join at the slightly thinner part, called the neck. The crown is that part visible in the mouth. The root is inside the jaw and holds the tooth in place

(Fig 1.1). Teeth are of different shapes and sizes depending on their functions.

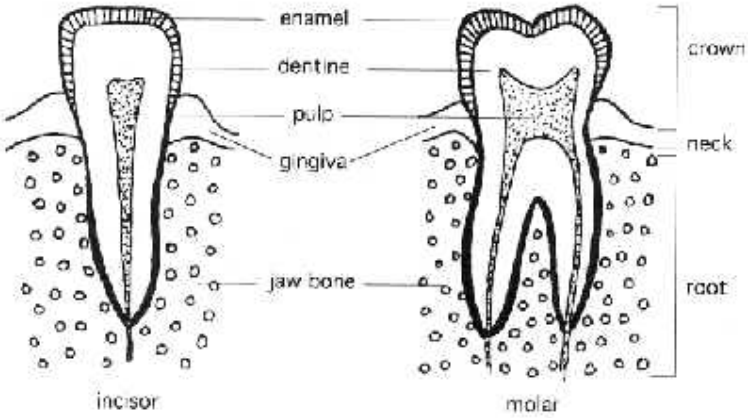


Figure 1.1
Teeth are attached to the jaw by their roots: a cross-sectional view of an incisor and a molar tooth.

The **crown** of a tooth is covered with **enamel**. This is the hardest tissue in the body. Under the enamel lies the **dentine**. This is hard also and makes up the main part of the tooth. However, it is not as hard as enamel. It is a living tissue and can become painful and sensitive under certain circumstances.

In the middle of the tooth is the **pulp**. It contains nerves and blood vessels, which enter the tooth through a very fine hole in the tip of the root. The pulp connects the tooth to the rest of the body and is the source of all nutrition to the tooth as well as all pain sensation.
The tissue that surrounds a tooth and covers the **jawbone** is called the gum or **gingival** (Fig. 1.1). Healthy gingival tissue fits closely around the tooth and feels firm to the touch and does not bleed if you press on it gently. Bleeding gingiva indicates gum disease and the need for better cleaning of teeth.

During our growing period we get two sets of teeth. The primary teeth develop during the first two years. These then are gradually replaced by the permanent teeth between the age of 6-12 years.

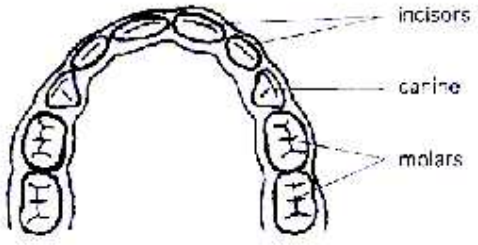
Primary Teeth

There are 20 primary teeth, 10 in each jaw (Fig. 1.2). In each jaw there are:

- four front teeth: the incisors,
- two canines,
- four molars.

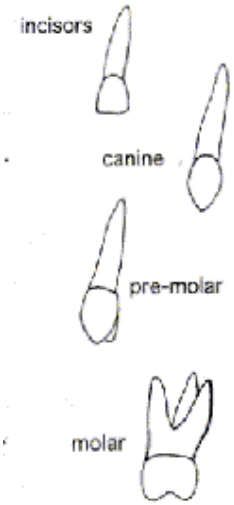
The primary teeth are much smaller, more round and whiter than the permanent teeth.

Figure 1.2
The primary teeth;
looking at the chewing sufaces



Permanent Teeth

Adults usually have 32 permanent teeth, 16 in each jaw (Fig. 1.3).
In each jaw there are:



- Four front teeth (**incisors**). These are shaped like a shovel with a wide edge for biting; they have one root. The upper incisors are bigger than the lower ones.

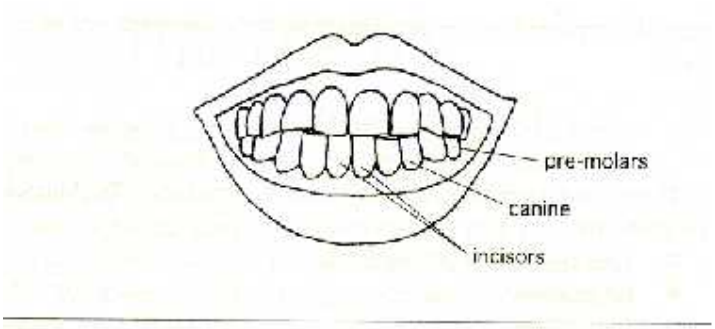
- Two **canines** which are similar in the upper and lower jaws. They are the strong, pointed teeth at the corners of the mouth. They have only one root.

- Four **premolars** which look like small molars. The crowns are round rather like the shape of a tin can; they have two cusps, one next to the cheek and one next to the tongue. Most pre- molars have one, some have two roots.

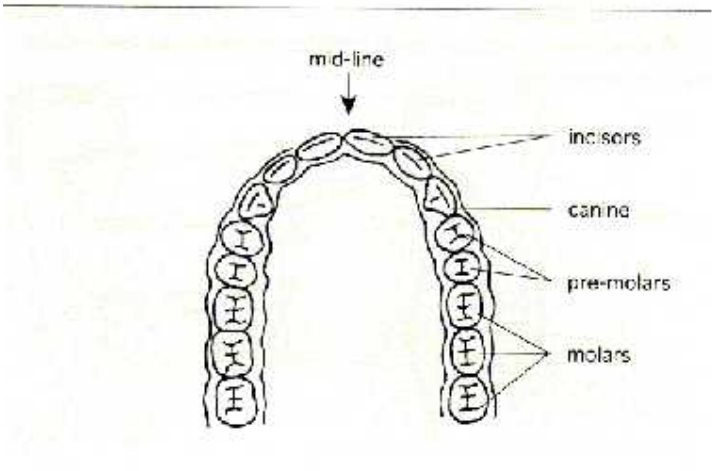
- Six **molars.** These are the large teeth at the back of the mouth used for grinding food. All molars have square crowns, like building blocks. They may have three, four or five cusps.
The molars in the upper jaw have three and those in the lower jaw two roots.

Figure 1.3

a. looking at the front of the mouth



b. looking at the chewing surfaces

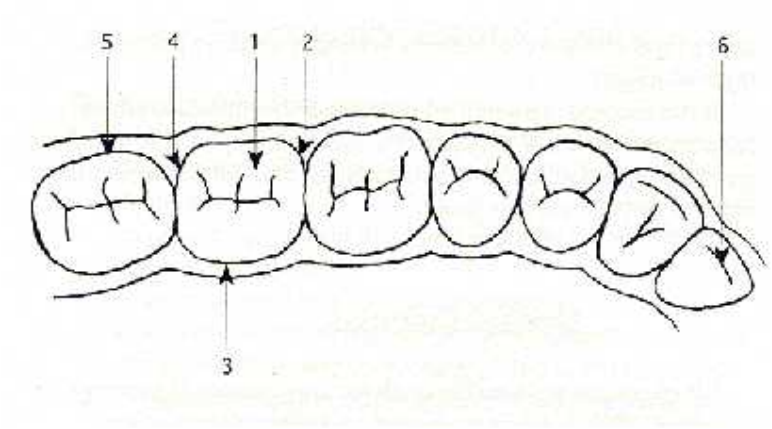


The following names are used for the surfaces of the teeth (Fig. 1.4):

1.	**Occlusal surface**	- the chewing surface of molars and premolars.
2.	**Mesial surface**	- the surface nearest the midline of the body.
3.	**Lingual surface**	- the surface nearest to the tongue in the lower jaw; it is called the palatal surface in the upper jaw.
4.	**Distal surface**	- the surface furthest from the midline.
5.	**Buccal surface**	- the surface nearest to the lips and cheek.
6.	**Incisal edge**	- the incisors and canines have a cutting edge instead of an occlusal surface.
7.	**Proximal surfaces**	- surfaces that are close together, i.e.; the mesial surface of one tooth may touch the distal surface of the next tooth. The two surfaces are described as proximal surfaces.

Figure 1.4

The permanent teeth: the names of the tooth surfaces



Dental Plaque and Calculus

In the mouth there are billions of living bacteria. Most of these bacteria are harmless. Some of them help in the digestion of our food. **Dental plaque** is the soft, white or yellow layer that sticks to the teeth. Plaque is made up mainly of bacteria. It also contains remains of saliva, various blood cells and particles from food.

Plaque builds up:

- where the gum meets the neck of the tooth,
- in the grooves (fissures) of the chewing (occlusal) surfaces of the teeth,
- in the narrow areas between the teeth (proximal surfaces).

Since plaque is the cause of both tooth decay and gum disease, these are the places where these oral diseases generally start. Plaque is found on teeth in everybody's mouth. But some people have much more than others do. These people are more likely to develop gum disease and tooth decay.

Formation of Plaque

Immediately after the teeth have been cleaned, new plaque begins to grow on the tooth surfaces. A very thin layer of saliva components forms on all oral surfaces. Bacteria settle on this saliva layer and start to multiply until they form an unbroken layer of plaque.
If the bacteria are supplied with sugar they produce sticky substances that allow the plaque to grow quickly. If plaque is not removed each day its composition changes and it becomes more harmful to the teeth and gums.

Dental Calculus
When plaque stays on the teeth for long periods it becomes very hard. This is because calcium and other minerals from saliva and some foods settle in the plaque. This new substance is called calculus. Some facts about calculus are mentioned below.

- Young calculus is light yellow, and has a rough surface that is easily stained dark by foods, tea and tobacco.
- The surface is always covered with soft, bacterial plaque.
- Calculus can be found on any surface of all teeth,
- Most frequently, larger amounts of calculus are found close to the openings through which saliva comes into the mouth.

Dental Caries

The most common oral disease is **dental caries**. This is the disease that destroys the enamel and the dentine of the tooth. It starts with loss of minerals from the enamel surface. At this early stage the process can be reversed. If the caries is not stopped, a cavity will form in the dentine. The process is progressive and may end with total destruction of the entire tooth crown.

Caries may progress slowly or rapidly. This depends on many factors like diet, saliva composition, number of bacteria, oral hygiene and other habits. Caries progression, therefore, may vary from person to person and from population to population. It may take years for caries to create a large cavity if progression is slow. But the same process may need only a few months, if progression is fast. When caries has reached the dentine, the tooth can become sensitive and the person may feel this as tooth-ache. The patient may complain of pain when eating sweets, something hot or cold, or when biting on something hard. This is because the pulp is either inflamed or infected by bacteria.

Recognizing Dental Caries

The signs of dental caries are:
ι break in the enamel or a cavity in the tooth,
he dentine in the cavity is softer than the surrounding dentine,
ın area in the enamel that has a different color from the surrounding enamel

Color can thus be a sign of the presence of caries.
Caries that is progressing rapidly is usually rather light in color whilst slowly progressing caries is usually darker. Sometimes, however, pits and fissures are dark colored not because of dental caries, but because of staining due to some foods.

The Causes of Dental Caries

Some of the bacteria which accumulate in plaque can digest sugar and turn it into acid. If left on the tooth, acid will attack the enamel and dissolve it.

Bacteria + food and drink
containing sugar
|
V
Acid
|
V
Caries

Sugar is easily digested by bacteria and acid is produced rapidly. Plaque becomes acidic very quickly. This means that sugary foods are dangerous for teeth particularly if they are eaten often. Other foods like rice, flour, potatoes and maize contain starch, which is another form of sugar. Starch is digested and converted to acid much more slowly than sugar. So, starchy foods are less dangerous for teeth.

The places on the teeth where caries begins most often are:

- pits and fissures on the occlusal surfaces,
- pits and fissures on buccal and lingual surfaces,
- the areas where teeth touch each other, the proximal surfaces,
- around the neck of the teeth near the gingiva.

The Development of Dental Caries

Caries begins on the enamel of the tooth (Fig 1.5a). In the early stages there are no symptoms. The first sign that can be seen is a change in the color of the enamel; it turns whitish. This change is because the acid produced by the bacteria in the plaque has dissolved some of the minerals in the enamel (mainly calcium phosphate). But there is no hole, because a lot of the minerals remain. At this stage, the decay can be arrested and the enamel made sound again by the minerals in the saliva and plaque. But for this to occur, the tooth must be kept clean, so that there are few acid attacks. Fluoride, as found in toothpaste, can also help in the healing of early caries.

If efforts to arrest the decay are not made, the dentine is then attacked. It becomes soft, spongy and yellow and the enamel becomes undermined (Fig 1.5b). The decay then spreads through the dentine towards the pulp. At this stage the tooth may be painful when cold, hot or sweet foods are eaten, or after biting on hard things. This is because the pulp is inflamed.

If a cavity is not treated with a restoration, the caries will continue to destroy the tooth; the hole will become bigger and the caries will reach the pulp. The patient may then complain of toothache.

The pain may be:

- continuous and intense,
- throbbing like the pulse or
- a shooting pain like a stabbing knife.

The destruction of the tooth crown can produce sharp enamel edges that hurt the tongue, cheeks or lips. The caries may destroy the tooth completely and it may have to be extracted

(Fig 1.5c). Teeth are most likely to decay during childhood and adolescence when they are new in the mouth. Often the first molars, which enter the mouth at six years, are the first permanent teeth to decay.

However, not all decay in dentine spreads further. There are ways to arrest decay. Arrested decay is dark in color and is hard. However, the affected tooth may still need to be restored to prevent the tongue or lips or cheeks from being cut on the sharp edges of the enamel.

Complications

When the caries reaches the pulp, it can result in several complications:(Fig. 1.5d)

The pulp will die after some time,
an abscess or cyst may form in the bone around the end of the root,
the abscess may grow into a tender swelling in the mouth.

These conditions are often extremely painful. The tooth may be tender to bite on and if you tap the tooth vertically on the occlusal surface there will be sharp pain. However, pain may disappear after a while. But that does not mean that the caries has disappeared also.

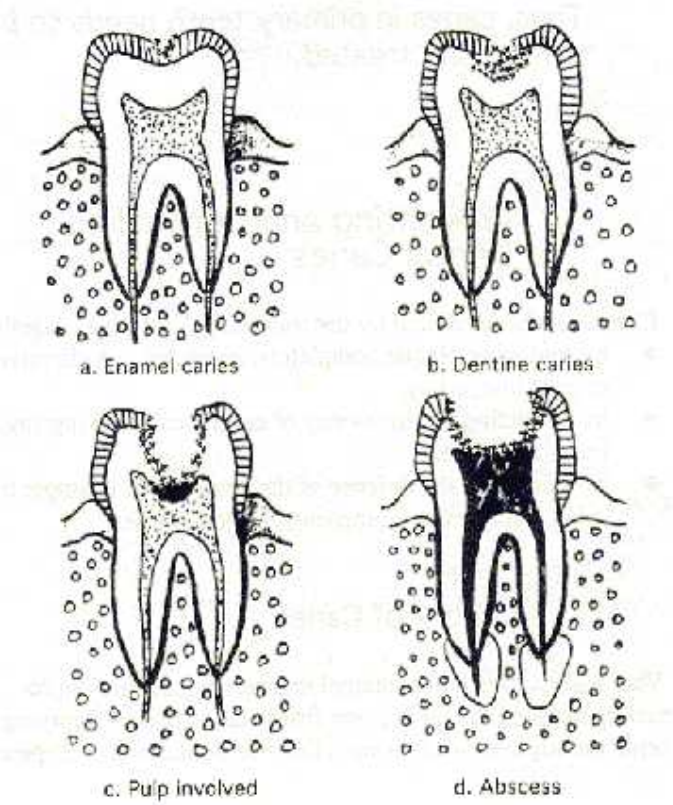
Figure 1.5
The development stages of dental caries

a. Enamel caries: No pain

b. Dentine caries:maybe sensitive to hot, cold and sweet
foods/drinks and eating hard things; there may be pain

c. Pulp involved: severe continuous or throbbing pain

d. Abscess: deep acute pain which may disappear after a while.



Progression and Complications in the Primary Dentition

The progression of caries in primary teeth is very similar to its development in permanent teeth. However, the primary teeth are much smaller than permanent teeth and the layers of enamel and dentine are thinner. Caries in primary teeth, therefore, progresses much faster into dentine and thereafter the pulp than in permanent teeth. While some people consider that

decayed primary teeth do not matter because they are replaced by permanent teeth, it must be remembered that:

- decay in primary teeth can be very painful,
- the experience of an extraction is very threatening for a small child,
- the developing permanent teeth can be damaged by abscesses around the roots of primary teeth,
- the eventual position of the permanent teeth can be disturbed if the primary teeth are extracted ea

Thus, caries in primary teeth needs to be prevented and treated.

Preventing and Controlling Dental Caries

Caries can be prevented by the following 3 activities together:

– by removing plaque completely, carefully and effectively at least once a day,
– by restricting the frequency of eating and drinking sugary foods and drinks,
– by increasing the defense of the enamel, for example by using fluorides in toothpastes or mouthrinses.

Control of Caries

Very early caries in the enamel can be stopped or even reversed by keeping the teeth clean from plaque and by applying a fluoride mouthrinse or by using a fluoride containing toothpaste. If the fissures are deep, a fissure sealant to close over and protect the area can be applied (Chapter 6). However, once the caries has reached the dentine and a cavity has formed, it is necessary to remove the decayed dentine and repair the cavity to stop the caries. A good way to do this is by placing an adhesive restorative material, such as glass-ionomer, into the cavity. This material will stick closely to the tooth and form a seal between the restoration and the tooth. It so prevents any more bacteria getting into the cavity. Glass-ionomers also release fluoride into the surrounding tooth structures and make them stronger against further attack from bacterial acid.

Chapter 2 - ART: What One Should Know

ART is not suitable for all tooth cavities. A proper diagnosis of cavities which can and cannot be treated, is essential for the successful treatment of caries. This chapter presents the principles of the ART approach and indicates where the approach will be most successful.

Principles of ART

The two main principles of ART are:

- removing carious tooth tissues using hand instruments only, and
- restoring the cavity with a restorative material that sticks to the tooth.

Currently, ART is performed using glass-ionomer as the restorative material.

The reasons for using hand instruments rather than electric rotating handpieces are:

- it makes restorative care accessible for all population groups,
- the use of a biological approach, which requires minimal cavity preparation that conserves sound tooth tissues causes less trauma to the teeth,
- the low cost of hand instruments compared to electrically driven dental equipment,
- the limitation of pain that reduces the need for local anaesthesia to a minimum and reduces psychological traur patients,
- simplified infection control. Hand instruments can easily be cleaned and sterilized after every patient.

The reasons for using glass-ionomer are:

- as the glass-ionomer sticks chemically to both enamel and dentine, the need to cut sound tooth tissue to prepa cavity is reduced,
- fluoride is released from the restoration to prevent and arrest caries and,
- it is rather similar to hard oral tissues and does not inflame the pulp or gingiva.

For these reasons, ART provides preventive and curative treatment in one procedure.

Identification of Carious Cavities Suitable for ART

In the previous chapter, the stages in the development of dental caries have been described.
In general, **ART can be applied when**:

- there is a cavity involving the dentine, and
- that cavity is accessible to hand instruments.

ART should *not be used* when:

- there is presence of swelling (abscess) or fistula (opening from abscess to the oral cavity) near the carious tooth,
- the pulp of the tooth is exposed,
- teeth have been painful for a long time and there may be chronic inflammation of the pulp,
- there is an obvious carious cavity, but the opening is inaccessible to hand instruments,
- there are clear signs of a cavity, for example in a proximal surface, but the cavity cannot be entered from the proximal nor the occlusal directions.

What percentage of carious cavities can one expect to be inaccessible and where are these situated in the mouth.

In a study carried out among 14-year-old children in Zimbabwe, 16% of the cavities in permanent teeth could not be treated with ART. Cavities with suspected or definite pulpal involvement were not included in this number. Most of the cavities which could not be treated were found in proximal surfaces only, particularly in front teeth.

Carious cavities are usually classified by the number of surfaces affected.

One-Surface Cavities

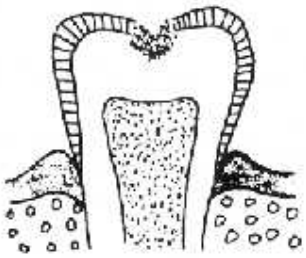
These occur in only one surface of a tooth, i.e.:

a. in pits and fissures on occlusal surfaces of premolars and molars,
b. in pits on lingual surfaces of upper incisors,
c. in buccal and lingual grooves of molars,
d. in buccal and lingual surfaces just above the gingiva of all teeth,
e. in proximal surfaces.

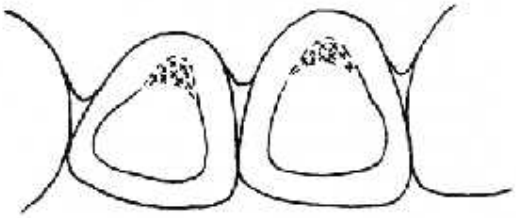
Examples of these situations are illustrated in figure 2.1

Figure 2.1
Various types of one-surface carious cavities

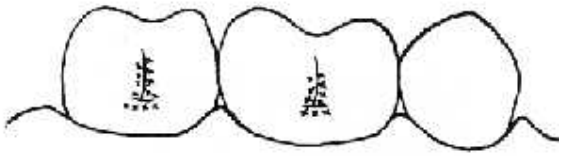
a. Pits and fissures on occlusal surfaces of premolars and molars.



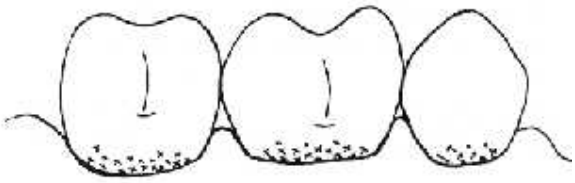
b. Pits on lingual surfaces of upper incisors



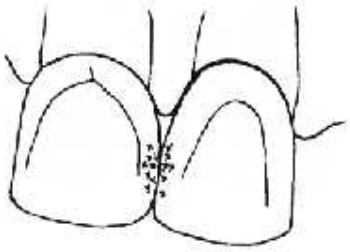
c. Buccal groove of lower molars



d. Buccal surfaces just above the gingiva.



e. Proximal surfaces of anterior teeth.

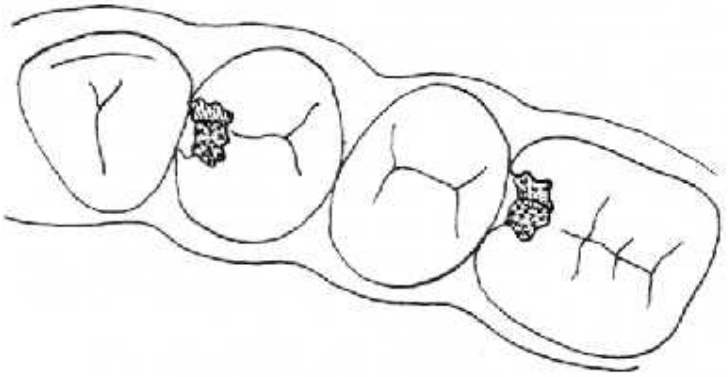


Multiple-Surface Cavities

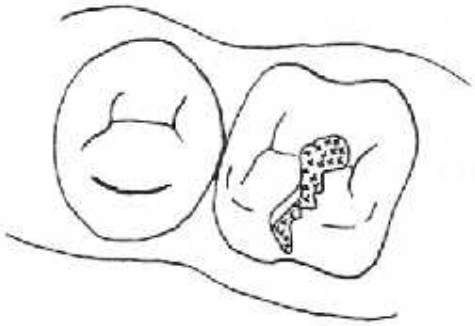
These affect two or more surfaces of a tooth, i.e.:
a. occlusal and proximal surfaces of premolars and molars,
b. occlusal, and buccal or lingual surfaces of premolars and molars,
c. proximal, and buccal or lingual surfaces of anterior teeth.

Examples of these situations are illustrated in figure 2.2.

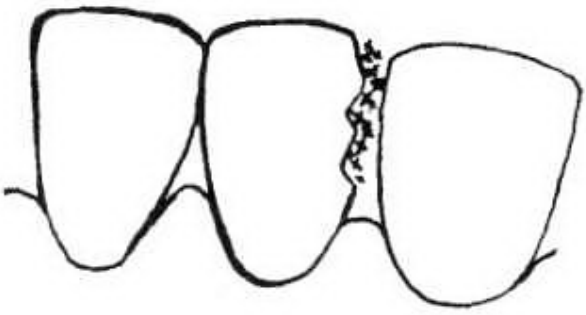
Figure 2.2
Various types of multiple-surface carious cavities.



a. Occlusal and proximal surfaces of a premolar and a molar.



b. Occlusal and lingual surfaces of a molar.



c. Proximal and buccal surfaces of an anterior tooth.

Application of ART

Based on studies already conducted, ART can certainly be used with confidence in one-surface cavities particularly in permanent teeth. For example, results of field studies in Thailand and Zimbabwe have shown that 71% and 85% of the one-surface ART restorations respectively, are in good shape after three years. It is expected that ART will perform equally well in one-surface cavities in primary teeth. Unfortunately, limited information is available at the moment to support this assumption. In primary teeth, ART restorations do not need to stay in place for long since these teeth will eventually be replaced by permanent teeth. The maximum time a restoration needs to remain in a primary tooth is about 6 years. ART restorations can help maintain a natural tooth eruption pattern and avoid disturbances in the positions of permanent teeth.

Success of ART in multiple-surface cavities very much depends on the size of the cavity and the restorative material used. Small to medium size multiple-surface cavities can be confidently treated with ART. Restorations placed in large cavities may not stay in place for a long time. This is because the glass-ionomers currently available are not strong enough for this application. However, glass-ionomers with improved qualities are being developed. We can expect in the future that improved materials appropriate for use in large size cavities will become available.

As ART does not require electrical driven dental equipment, carious cavities can be treated almost everywhere. ART can be applied, not only in the dental clinic, but also in institutions for home-bound, physically and mentally handicapped people, in remote areas and in schools. It is certainly patient friendly and makes the provision of oral care much easier to patients who are nervous or fearful.

Chapter 3 - What to do before applying ART

Before you actually start the Atraumatic Restorative Treatment of a carious lesion in a tooth, you should know how to:

- **arrange a good working environment in and outside the mouth,**
- **select and to use the correct instruments,**
- **control cross infection,**
- **use the glass-ionomer material.**

This chapter provides the knowledge needed for these activities.

3.1 Arrangements outside the Mouth

Introduction

Restorative oral health care tasks require precise work and high levels of control as they are performed in the restricted area of the mouth. The correct positioning of both the operator and patient is essential to achieve good quality care. This section describes the most appropriate working positions for both oral examination and treatment.

The operator's work posture and positions

The work posture and position of the operator should provide the best view of the inside of the patient's mouth. At the same time, both patient and operator should be comfortable.
The operator sits firmly on the stool, with straight back, thighs parallel to the floor and both feet flat on the floor. The head and neck should be still, the line between the eyes horizontal and the head bent slightly forward to look at the patient's mouth (Fig. 3.1a).
The height of the stool must then be adjusted so that the operator can see the patient's teeth clearly. The distance from the operator's eye to patient's tooth is usually between 30 and 35 cm. It is important that the stool is adjusted to the correct height for the eye focus of each operator.
The operator should be positioned behind the head of the patient. The exact position will depend on the area of the patient's mouth to be treated. If the patient's mouth is considered to be at the center of a clock face, see Fig.3.1c, the range of positions from which the operator can perform all tasks lies on an arc from 10 to 1 on the clock. The direct rear position i.e. at 12 o'clock and the right rear position i.e. at 10 o'clock are the most commonly used positions.

Assistance

Oral care is best provided by a team consisting of an operator and an assistant. However, assistants may not always be available. In such a situation the operator will have to provide oral care alone. When treating patients, particularly children using ART, it is a great advantage if another person can mix the glass-ionomer. This allows the operator to concentrate on the cavity and maintain effective saliva control. The operator should first demonstrate the use of instruments and the mixing procedure and train that person until he/she is able to mix the liquid and powder together correctly.

Seating Position of Assistant

The assistant works at the left side of a right-handed operator and does not change position. The assistant should sit as close to the patient support as possible, facing the patient's mouth. The assistant's head should be 10 - 15 cm higher than the operator, so that the assistant can also see the operating field and can pass the correct instruments when needed (Fig. 3.2a). The assistant needs a flat stable surface i.e. a table for holding instruments and materials.

Working Alone

The operator sits in the appropriate position behind the patient. A small table for holding the instruments and materials is either placed at the head end of the patient or on the right-hand side of the operator close to the patient's body (Fig. 3.2b).

Patient Position

As with any other oral treatment, ART requires correct patient and operator positions. A patient lying on the back on a flat surface will provide safe and secure body support and a comfortable and stable position for lengthy periods of time. A headrest made of firm foam or a rubber ring with a cover, both stabilizes the patient's head in the desired position and improves the comfort of the patient.
So the patient should be placed on a flat surface, e.g. a bamboo or wooden bed, an appropriate portable dental bed, or a table (Fig. 3.3). Assuming that a table is present in most communities, a very acceptable patient position is created by attaching a head support to the end of the table. A layer of foam plastic will provide more comfort (Fig. 3.4). The patient is now positioned so that the saliva collects in the back of the oral cavity. The operating field is now over the operator's lap at the height of the operator's chest (Fig. 3.2a).

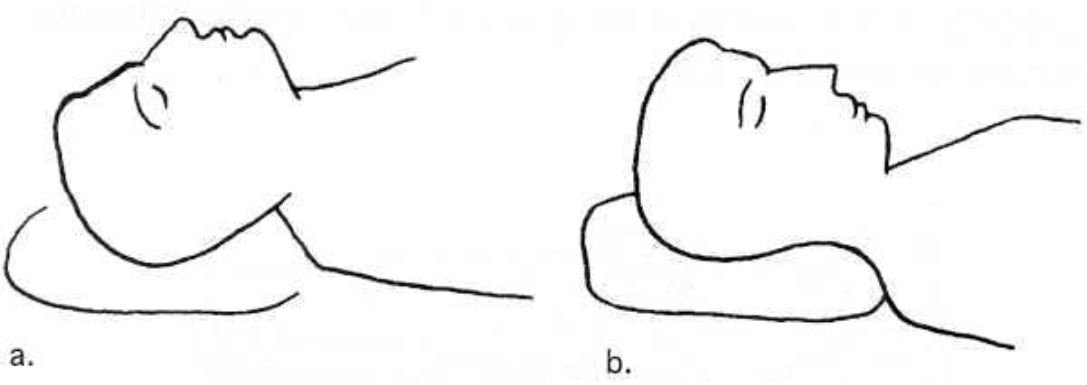
Patient's Head Positions

The patient can assist the operator by tilting, turning the head and opening the mouth wide enough to provide access to the area of operation. These three movements are needed so that the operator has good access and vision during oral care.
1. Tilting the head
a. Backward tilt lifting the chin for access to upper teeth (Fig. 3.5a)
b. Forward tilt dropping the chin for access to lower teeth (Fig. 3.5b)

Figure 3.5
Backward and forward tilt of the head

a. Backward tilt

b. Forward tilt



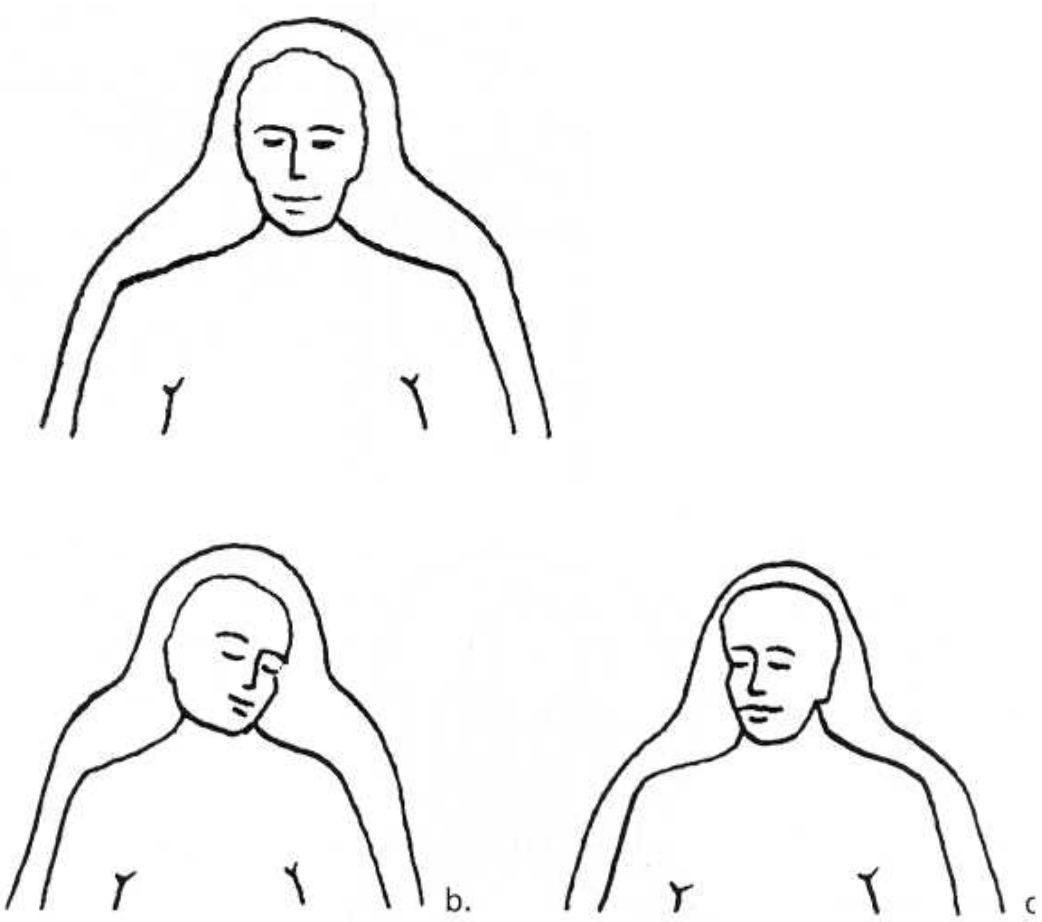
2. Turning the head
a. Central position
b. Left turn
c. Right turn

Figure 3.6
Positions resulting from turning the patient's head

a. Central position

b. Left turn

c. Right turn



3. Mouth opening
a. Fully open.
b. Partly closed, to relax the cheek muscles for better access to buccal surfaces. The mirror is then used to hold the cheek away from the buccal surfaces.

Operating Positions

Operating positions are indicated by the location of the operator, the three positions of the patient's head and the type of vision - mirror or direct. The positions given are for right-handed operators and must be interchanged for left-handed operators.

a. Position for Upper Right Posterior Tooth Surfaces

The operator sits directly behind the patient's head. Mirror vision is used and the patient's head is tilted backwards with the mouth fully open (Fig. 3.7). Turning of the patient's head will depend on the surfaces to be treated on, i.e. for an occlusal surface - the central position, for a palatal surface of an upper right molar - turned slightly to the right, for a buccal surface of an upper right molar - turned slightly to the left.

Figure 3.7
Position for upper right posterior
- occlusal surfaces

operator
- direct rear

vision
- mirror

patient's head
- backward tilt
- central position
- mouth fully open

b. Position for Upper Anterior Tooth Surfaces

The operator sits directly behind the patient. Tilt the patient's head backward with the mouth open. The buccal surfaces are then viewed directly and the lingual surfaces are viewed through the mouth mirror.

c. Position for Upper Left Posterior Tooth Surfaces

For occlusal and buccal surfaces, the operator sits directly behind the patient's head. Tilt the patient's head backwards and turn it slightly to the right with the mouth fully open for occlusal and partly closed for buccal surfaces. A mirror is used to view the surfaces (Fig. 3.8).
For working on the palatal surface, the operator sits slightly to the right of the patient's head. Tilt the patient's head backwards and turn it slightly to the left with the mouth fully open for direct vision.

Figure 3.8
Position for upper left posterior
- occlusal surfaces

operator
- direct rear

vision
- mirror

patient's head
- backward tilt
- turned to the right
- mouth fully open

d. Position for Lower Left Posterior Tooth Surfaces

The operator sits to the right rear of the patient's head. The patient's head is placed in the central position and tilted slightly forwards. For occlusal and buccal surfaces, turn the head slightly to the right. The mouth should be fully open for occlusal views and partly closed for buccal surfaces to allow access for the mouth mirror. Direct vision may be used for most of the lower teeth (Fig. 3.9).

Figure 3.9
Position for lower left posterior
- occlusal surfaces

operator
- right rear

vision
- direct

patient's head
- forward tilt
- turned to the right
- mouth fully open

e. Position for Lower Anterior Tooth Surfaces

The operator sits directly behind the patient's head. Tilt the patient's head forwards in the central position. The mouth should be fully open and direct vision is used.

f. Position for Lower Right Posterior Tooth Surfaces

The operator sits to the right rear of the patient's head, which should be tilted forwards. For occlusal and lingual working surfaces, turn the head slightly to the right with the mouth fully open for direct vision. To view the buccal surfaces, turn the head slightly to the left with the mouth partly closed to allow access for the mouth mirror and hand instruments (Fig. 3.10)

Figure 3.10
Lower right posterior position
- occlusal and lingual surfaces

operator
- right rear

vision
- direct

patient's head
- forward tilt
- turned to the right
- mouth fully open

Operating Light

Good vision is essential for working in the oral cavity. The light source can be the sun (natural) or artificial. Artificial light is more reliable and constant than natural light and can also be focused on a particular spot. Therefore, in a field setting a portable light source is recommended e.g. a headlamp, glasses with a light source attached or a light attached to the mouth mirror. For all these three light sources, a rechargeable portable battery is the source of energy.

Figure 3.11
Glasses with a light source attached

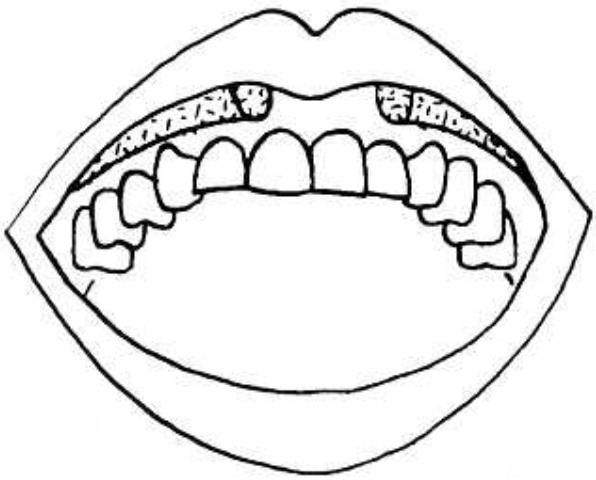
3.2 Arrangements in the Mouth

A Dry Operating Area

A very important aspect for the success of ART is control of saliva around the tooth being treated. Cotton wool rolls are quite effective at absorbing saliva and can provide short-term protection from moisture/saliva. Rolls can be either bought or prepared from bulk cotton dressing pack. They must be changed when they have absorbed saliva. The location in the mouth and method of placement of cotton wool rolls is described below.

a. Upper Teeth
Retract the lip and cheek with the mouth mirror to make space between the cheek and teeth for the cotton wool roll (Fig. 3.12). Place the cotton wool roll in position with a slight rotating action from the tooth towards the gingiva. This will help prevent the cotton wool roll from coming out easily. Always place cotton wool rolls in the sides of the mouth, as in the mid-line position, they will be easily dislodged (Fig. 3.12).

Figure 3.12
Correct positions of cotton wool rolls in the upper jaw



b. Lower Teeth

Ask the patient to stick the tongue out. Push the tongue aside with the mouth mirror. Place a cotton wool roll on each side of the floor of the mouth. Then ask the patient to retract the tongue back to its normal position. Also place a cotton wool roll in the buccal part of the upper jaw on the same side as the tooth to be treated.

Figure 3.13 illustrates the correct positions of cotton wool rolls in the lower jaw. Note that tension from the lip may dislodge the cotton wool roll if placed centrally.

Figure 3.13
Correct positions of cotton wool rolls in the lower jaw

3.3 Essential Instruments and Materials

Introduction

The correct instruments should be used for each treatment procedure. The success of any treatment depends on the operator knowing the functions of the various instruments and using them correctly. They must also be properly maintained in a good condition. This section describes the instruments used to perform the cavity preparation and restoration and how to keep them sharp.

Instruments for ART

a. MOUTH MIRROR. This instrument is used to reflect light onto the field of operation, to view the cavity indirectly, and to retract the cheek or tongue, as necessary.

Figure 3.14 Mouth mirror

b. EXPLORER. This instrument is used to identify where soft carious dentine is present (Fig. 3.15). Do not poke the point into very small carious lesions. This may destroy the tooth surface and the caries arrestment process. Also do probe into deep cavities where you might damage or exposure the pulp.

Figure 3.15 Explorer

c. PAIR OF TWEEZERS. This instrument is used for carrying cotton wool rolls, cotton wool pellets, wedges and articulation paper from the tray to the mouth and back.

Figure 3.16 Pair of tweezers

d. SPOON EXCAVATOR. This instrument is used for removing soft carious dentine (Fig. 3.17). (For use see chapter 4, Cavity Preparation).

There are three sizes:
small. The diameter of the spoon is about 1 mm. An example is the Ash 153-154. This instrument is for use in small cavities and for cleaning the enamel / dentine junction. As the

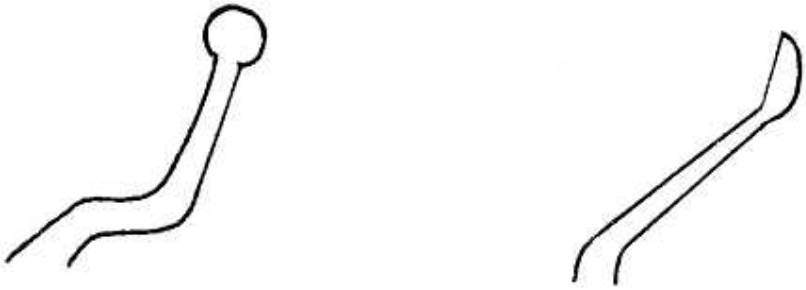
neck of the instrument is rather fragile, it can break if too much force is applied whilst excavating.

medium. The diameter of the spoon is about 1.5 mm. An example is the Ash 131-132. This instrument is mainly used for removal of soft caries from larger cavities. The rounded surface of the spoon can also be used to push mixed restorative material into small cavities.

large. The diameter is about 2 mm. An example is the Ash 127-128. This instrument can be used in large cavities and for removing of excess glass-ionomer material from the restoration. The enlarged working blade of the excavator is illustrated in Fig 3.18.

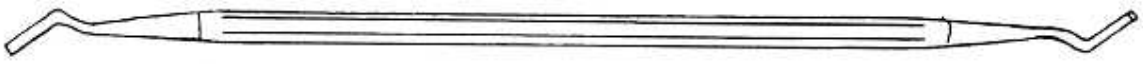
Figure 3.17 Spoon excavator

Figure 3.18 Enlarged working blade of excavator



e. DENTAL HATCHET. This instrument is used for widening the entrance to the cavity, for slicing away thin unsupported and carious enamel left after carious dentine has been removed. The width of the blade of the instrument is approximately 1 mm. An example is the Ash 10-6-12 (Fig. 3.19). Figures 3.20 and 3.21 show enlarged views of the working blades of the dental hatchet.

Figure 3.19 Dental hatchet



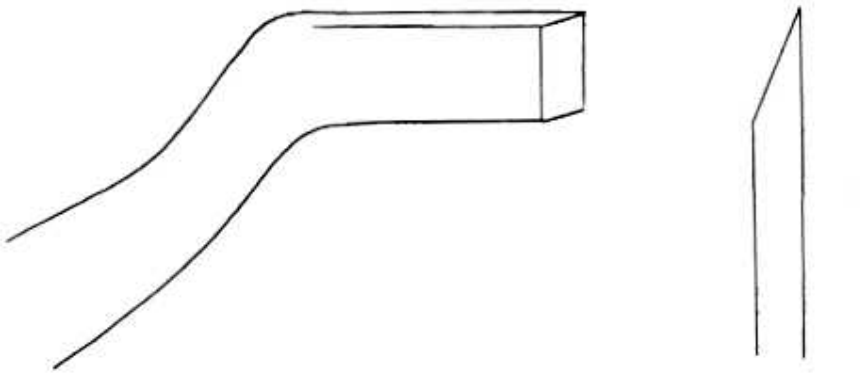


Figure 3.20 Enlarged working blade of dental hatchet

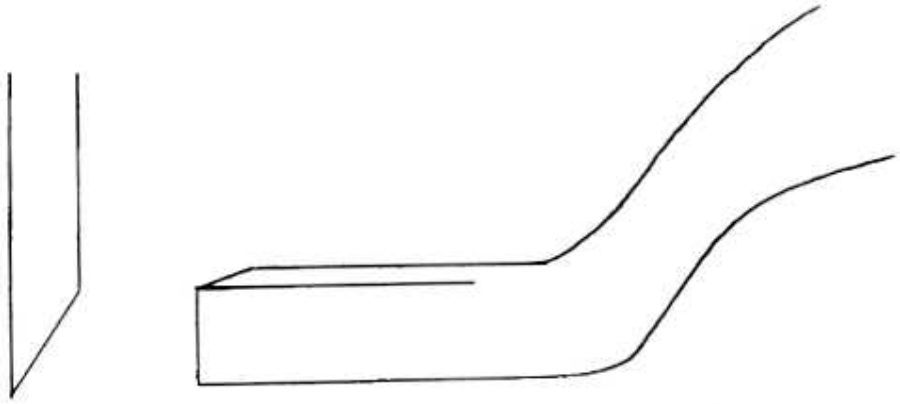


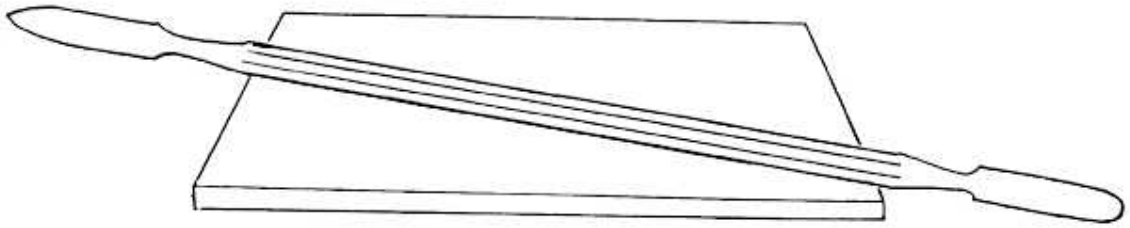
Figure 3.21 Enlarged working blade of other side of dental hatchet

f. APPLIER/CARVER. This double-ended instrument has two functions. The blunt end is used for inserting the mixed glass-ionomer into the cleaned cavity and into pits and fissures. The sharp end is designed to remove excess restorative material and to shape the glass-ionomer. An example is the Ash 6 Special (Fig.3.22).

Figure 3.22 Applier / Carver instrument

g. MIXING-PAD and SPATULA. These are necessary for mixing glass-ionomer (Fig. 3.23). There are two types of mixing pads; glass-slab and disposable paper pad. The spatula may be made of metal or plastic. The spatula used must bend so that it is easy to mix the powder and liquid rapidly and correctly. Sometimes glass-ionomer is supplied together with a plastic spatula and the paper pad.

Figure 3.23
Glass-slab
and spatula

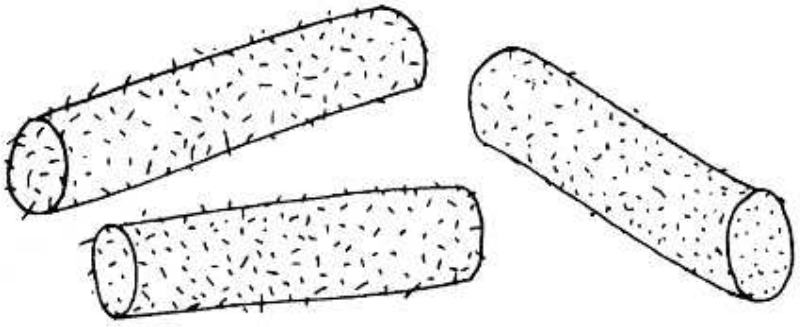


Materials for ART

Besides the adhesive restorative material glass-ionomer, there are a few other essential materials necessary to perform ART.

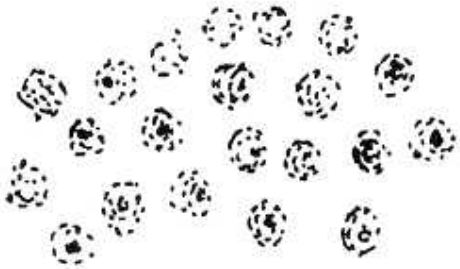
a. COTTON WOOL ROLLS. These are used to absorb saliva so that the tooth to be treated is kept dry.

Figure 3.24
Cotton wool rolls



b. COTTON WOOL PELLETS. These are used for cleaning cavities. They are available in various sizes. The smallest, size 4, should be used for small cavities. Size 2 can be used for larger cavities.

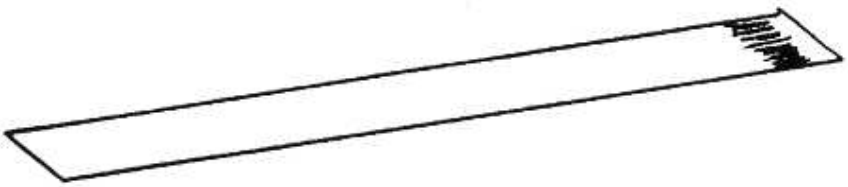
Figure 3.25
Cotton wool pellets



c. PETROLEUM JELLY. This material is used to keep moisture away from the glass-ionomer restoration and to prevent the examination glove from sticking to the glass-ionomer as it sets hard.

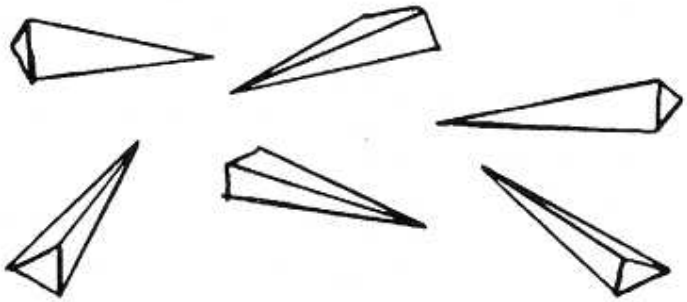
d. PLASTIC STRIP. This material is used for contouring the proximal surface of multiple-surface restorations (Fig. 3.26).

Figure 3.26
Plastic strip



e. WEDGES. These are used to hold the plastic strip close to the shape of the proximal surface of a tooth so that restorative material is not forced between the gums and teeth (Fig. 3.27). These wedges should be shaped from soft wood.

Figure 3.27
Wedges

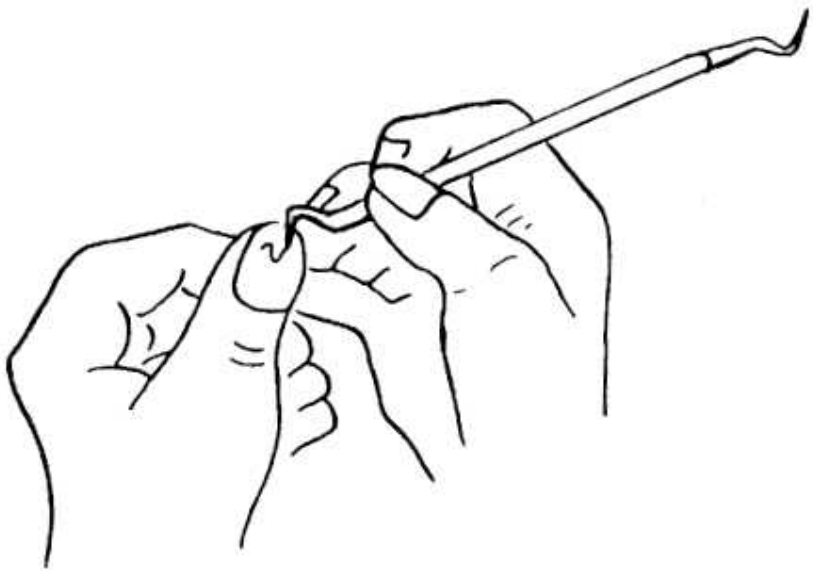


Sharpening Dental Instruments

Hand instruments used for cutting hard tooth tissues, the excavator, dental hatchet and carver, must be sharp to be effective.

A blunt instrument is a definite hazard, as it requires excessive force to cut enamel and dentine. The sharpness of the cutting edge can be tested effectively on the thumbnail. If the cutting edge digs in during an attempt to slide the instrument over the thumbnail, the instrument is sharp. If it slides, the instrument is blunt. Only light pressure is exerted in testing for sharpness (Fig. 3.28).

Figure 3.28
Testing the sharpness
of an instrument



Sharpening the Dental Hatchet and Carver

A special flat stone, for example an 'Arkansas' stone, is used for sharpening the hatchet, carver and spoon excavator. The procedure to follow is described below step-by-step.

1. Place the flat sharpening stone on a table.
2. Put a drop of oil on the stone.
3. Hold the stone firmly with one hand and rest the middle finger of the other hand on the stone as a guide.
4. Position the cutting edge of the hatchet or carver in the oil parallel to the surface of the stone (Fig 3.29).
5. Slide the instrument back and forth over the stone several times for maximum sharpness. Take care that the surface to be sharpened stays parallel to the stone surface.

Instruments should be sterilized after they have been sharpened.

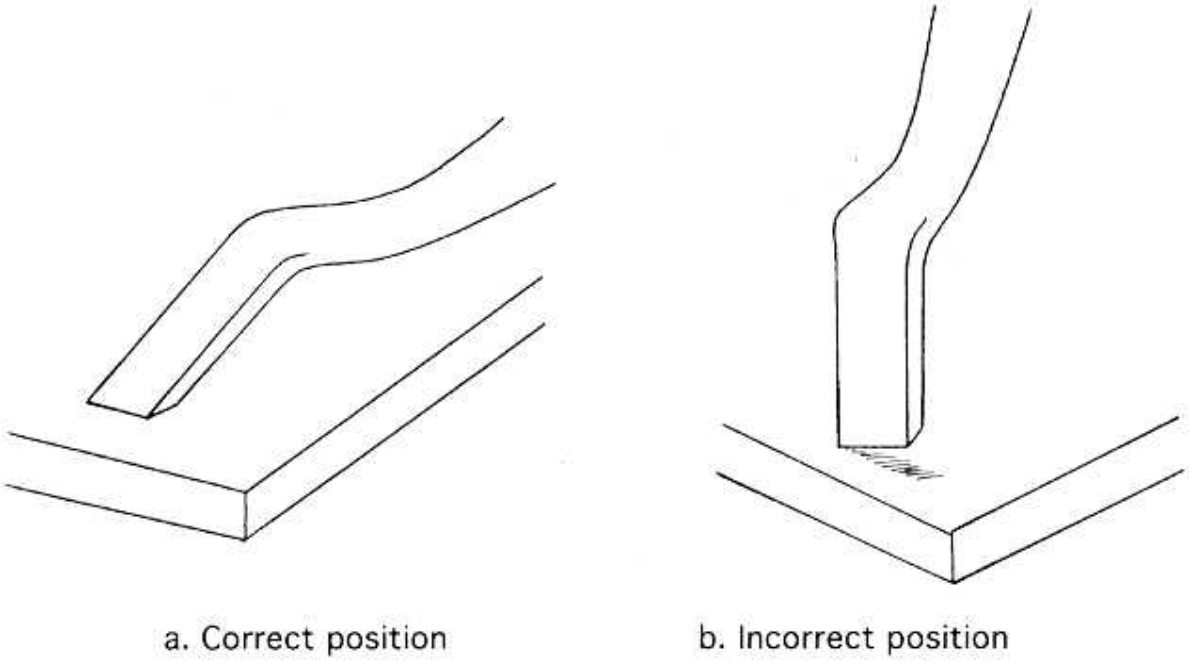
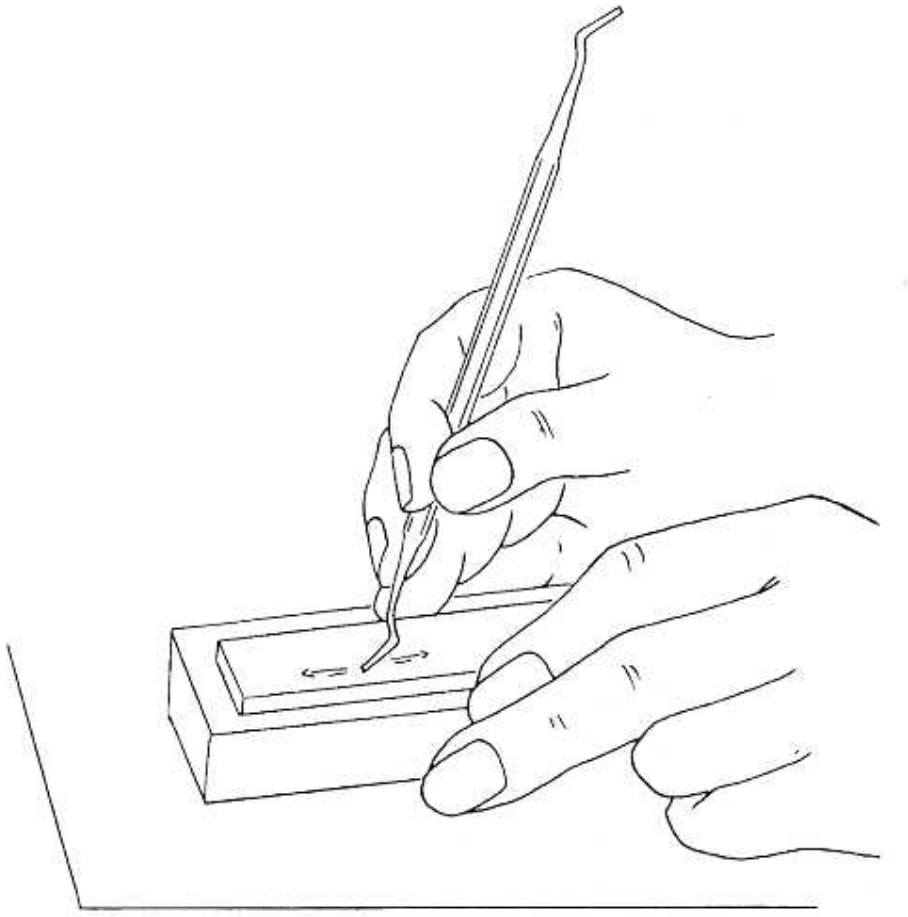


Figure 3.29 Correct and incorrect position of dental hatchet for sharpening

Instrument must be held parallel to the flat surface of the sharpening stone (Fig. 3.29a)

Figure 3.30 Positioning of fingers when sharpening hatchet and carver

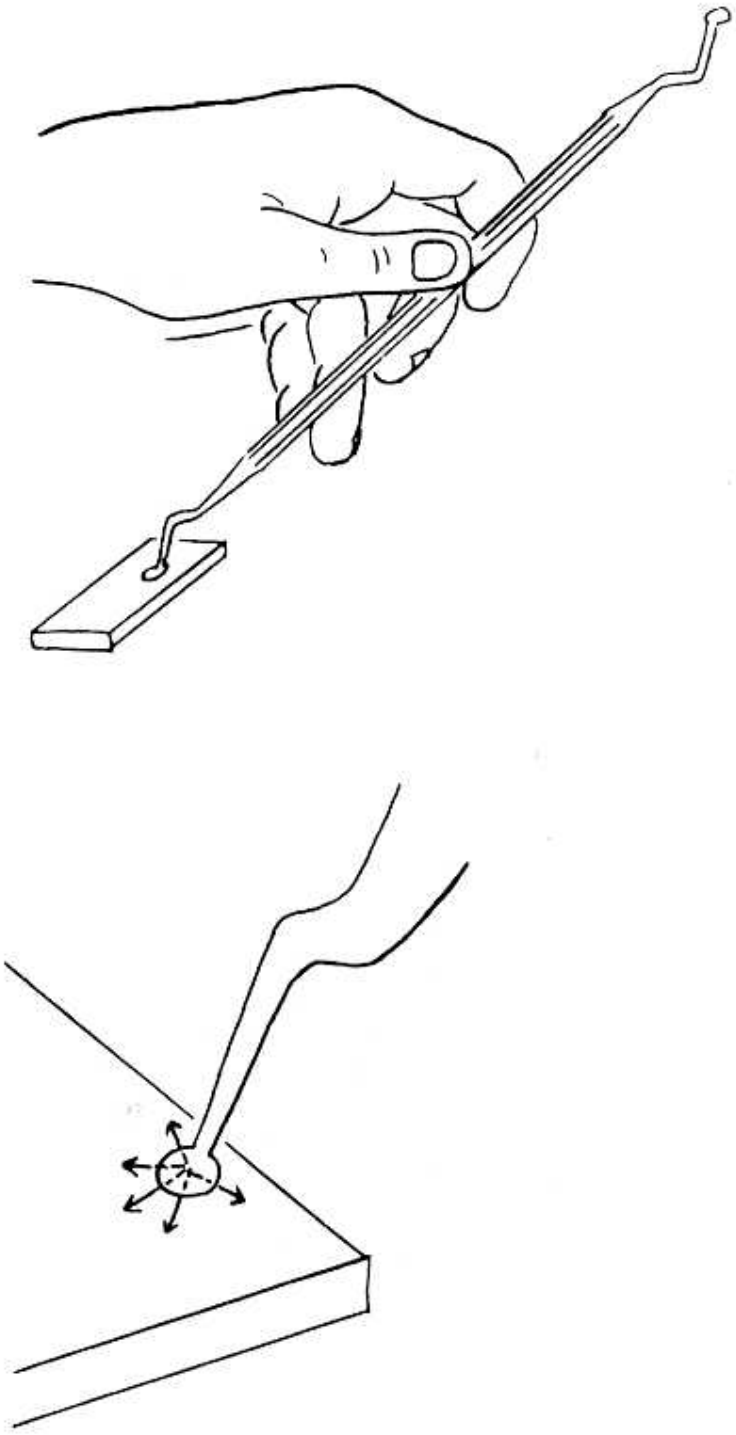


Sharpening Spoon Excavator

As for the dental hatchet and carver, a flat 'Arkansas' stone is used for sharpening. The procedure to follow is described below step-by-step.

1. Place the flat sharpening stone on the table.
2. Put a drop of oil on the stone.
3. Hold the stone firmly with one hand.
4. Place the round surface of the excavator in the oil and make small strokes from the center of the round surface to the edge of the spoon. Do this in all directions so that the entire cutting edge is sharpened.(Fig. 3.31)

Figure 3.31
Sharpening of spoon excavator



3.4 Hygiene and Control of Cross Infection

If available, always wear gloves. Cleaning and disinfection of the working place and sterilization of instruments is essential to prevent infection passing from operator to patients and vice versa or between patients via the operator. Cleaning and disinfection of surfaces in the working place can be done by using cotton gauzes impregnated with methylspirit

(alcohol). In a clinic, instruments can be sterilized in an autoclave or a pressure cooker. If not in the clinic, a pressure cooker or a pan with a lid to boil the instruments can be used.

To avoid the risk of infection with diseases such as the human immunodeficiency virus (HIV) and hepatitis B virus (HBV), all instruments must be sterilized before being used for each patient.

Cleaning and sterilizing instructions.

1. Place all instruments in water immediately after use.
2. Remove all debris from the instruments by scrubbing with brush in soapy water.
   If an autoclave is available, follow the manufacturer's instructions carefully.
   If a pressure cooker is available, the instructions presented below are useful.
3.In a field situation:

- Prepare fire using the fuel available - wood, gas, charcoal, solar energy.
- Put the clean instruments in a pressure cooker and add clean water to a depth of 2-3 cm from the bottom.
  (Read instructions supplied with the pressure cooker).
- Place the pressure cooker on the stove and bring to boil. When the steam comes out from the vent, put the weight in place.
  If available, set a timer for 15 minutes.
- Continue heating the pressure cooker on low heat for a minimum of 15 minutes. Ensure that steam continues to be released
  from the pressure cooker during this time. If this stops, there may be no water left in the pressure cooker anymore.
  If this happens remove the pressure cooker from the heat, add water and repeat the cycle.
  (Read the instructions supplied with the pressure cooker).

Take care when opening the pressure cooker.
Release the pressure first.

- Remove the pressure cooker from stove after 15 minutes, and leave it to cool.
- Take instruments out of pressure cooker with instrument forceps and dry them with a clean towel.
  Store them in a covered, preferably, metal box

If a pressure cooker is not available, instruments can be sterilized in a pan. Use a pan with a lid and boil them in water for a minimum of 30 minutes. Remove the instruments with instrument forceps immediately and dry them with a clean towel. Store the instruments in a covered, preferably metal box

3.5 Treatment Material

Introduction

The material used for restoring cavities and sealing pits and fissures is glass-ionomer. This material must be used correctly for achieving good results. This section describes the composition, characteristics and mixing procedures of glass-ionomer.

Glass-Ionomer as a Restorative Material

Composition

The material is supplied as a powder and liquid that must be mixed together. The powder is a glass containing silicon-oxide, aluminum-oxide and calcium fluoride. The liquid is either polyacrylic acid or de-mineralized water. If de-mineralized water is the liquid component,

polyacrylic acid is incorporated into the powder in a dry form. (de-mineralized or de-ionized water is used to top up batteries. It can be bought at garages)

Clinical Characteristics

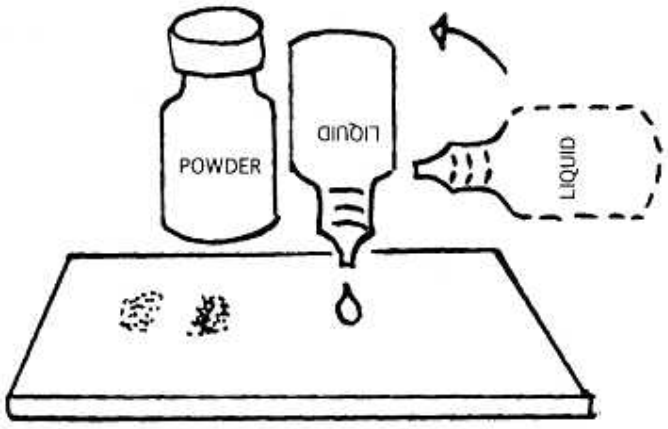
- Glass-ionomer bonds chemically to enamel and dentine and provides a good cavity seal.
- One of the most significant characteristics of glass-ionomer is the continued slow release of fluoride from the material
  after it has set. This helps prevent dental caries developing around the restoration.
- Glass-ionomer is not harmful to the pulp and gingiva. During setting, the material may cause the pulp to feel tender.
  After 24 hours, when completely set, adverse reactions do not occur anymore.
- Compared to established dental restorative materials, glass-ionomers have higher surface wear and lower strength.
  However, manufacturers are in the process of producing glass-ionomers of improved quality.
  Therefore the best type of glass-ionomers available should be chosen.

Mixing

It is essential to closely follow the handling instructions of the manufacturer particularly with respect to powder and liquid ratios. Place a spoonful of powder on the glass slab or mixing pad. Use the spatula to divide the powder into two equal portions, then dispense a drop of liquid next to the powder (Fig. 3.32). Hold the liquid bottle horizontal for a moment to allow air to escape from the tip. Move it to a vertical position and allow one drop of liquid to fall onto the slab.

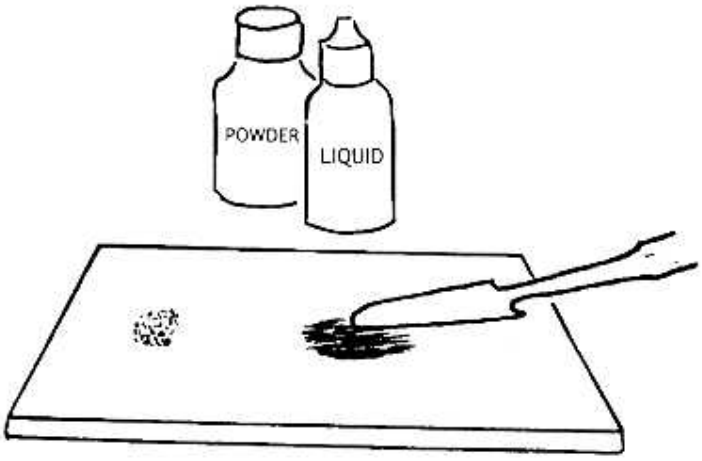
Apply a little pressure if necessary, but do not squeeze the liquid out.

Figure 3.32
Situation before mixing starts



First spread the liquid with the spatula over a surface of about 1.5 cm2. Start mixing by adding one half of the powder into the liquid using the spatula. Roll the powder into the liquid, gently wetting the particles without spreading them around the slab. As soon as all powder particles are wetted, the second portion is folded into the mix. Now mix firmly while keeping the mass together. The mixing should be completed within 20-30 seconds, depending on the brand of glass-ionomer used.
The final mixture should look smooth like chewing gum.

Figure 3.33
Mixing glass-ionomer



Restoring the Cavity

Insertion of the mixture into the prepared cavity and over the remaining fissures must begin immediately. Use the applier/carver to place small amounts of the mixture into the cavity. This technique will avoid air being trapped between the floor of the cavity and the glass-ionomer (voids). The entire application procedure must be completed within 30-40 seconds.

Precautions to Remember

Dispense both powder and liquid onto the slab only when you have the cavity properly dried and protected from saliva.
Replace the lid of powder and liquid bottle carefully back into position immediately after use. This prevents uptake of moisture from the air or evaporation of the water component from the liquid.
Wipe the nozzle of the liquid bottle with a damp gauze if liquid remains on the outside.
If more than 30 seconds are used for mixing and the mixture looks dry, do not use it, because there will be poor adhesion to the tooth structure. **Throw it away! Scrape the slab and spatula clean and start mixing again with new powder and liquid.**
Remove all glass-ionomer from the dental instruments **immediately** after use before the material has hardened, or put the instruments in water for easy cleaning later.

Each type of glass-ionomer may have its own specific needs. Therefore, follow the instructions of the manufacturers carefully.

Chapter 4 - Restoring One-Surface Cavities Using ART

In the previous chapters all the equipment and materials required to perform ART have been presented. This chapter describes the step-by-step stages and instruments needed for placing ART restorations for the treatment of one-surface cavities.

Preparing the Cavity

To start with, place cotton wool rolls alongside the tooth to be treated. This will absorb saliva and keep the tooth dry. Remove plaque from the tooth surface with a wet cotton wool pellet, and then dry the surface with a dry pellet. The extent of the caries can now be judged better. If the cavity opening in the enamel is small, widen the entrance. Do this by placing the blade of the dental hatchet into the cavity and turning the instrument forward and backward like turning a key in a lock. This movement chips off small pieces of carious enamel. If the cavity is very small, place a corner of the blade of the dental hatchet in the cavity first and then turn. Carious dentine can now be removed with the excavators. The small excavator is used for small cavities, the bigger one for larger cavities. Soft caries is removed by making circular scooping movements around the long axes of the instrument (Fig. 4.1). It is important to remove all the soft caries from the enamel-dentine junction **before** removing caries near the pulp.

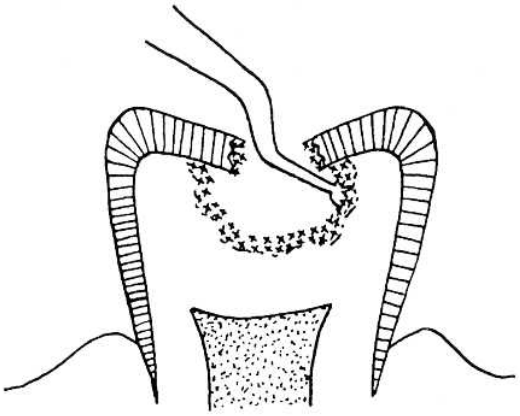


Figure 4.1
Circular scooping movements of the excavator

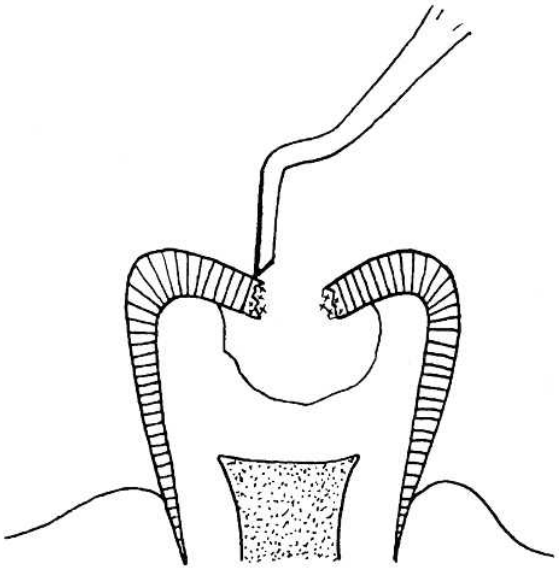


Figure 4.2
Fracturing off unsupported enamel with a hatchet

Removing soft caries from the enamel-dentine junction may leave enamel that is unsupported with dentine. The overhanging of enamel can break very easily and must be removed. Do this with the blade of the dental hatchet. Place the instrument at the edge of the enamel and fracture off small pieces (Fig 4.2).
Repeat this until all the thin unsupported enamel has been removed and no caries is left in the remaining enamel.

Remember, it is not necessary, and often not possible, to fracture off all unsupported enamel. Ensure that the dental hatchet is well supported with your fingers. As a result of removing this enamel, visibility and accessibility of the cavity is improved.

Particular care is needed when removing carious dentine from two places in the cavity:

- **the enamel-dentine junction.**

This part of the dentine is close to the surface of the tooth. It is also the part where the restoration must stick very well to the tooth. If caries is not completely removed at the junction, a good join is not made. Then bacteria will be able to penetrate in the gap between the restoration and the cavity wall, and caries will develop further.

- **the floor in deep cavities.**

When removing carious dentine near the pulp there is a risk of damaging or exposing the pulp. So it is important to remove no more dentine than really essential, in the deepest part of a cavity. If during cavity preparation the pulp is exposed there will be bleeding in most cases, in the bottom of the cavity. Then special treatment of the pulp or removal of the tooth is required. The choice of treatment will depend on the care available locally.

The excavated carious dentine can be placed on the cotton wool roll, positioned alongside the tooth or held by an assistant.
Excavation is easier done when the tooth is dry. Therefore, change saturated cotton wool rolls for dry ones.

After all caries is removed, the cavity is cleaned with wet cotton wool pellets. Then ask the patient to bite the upper and lower teeth together. This will show you how the tooth to be restored fits together with the opposing tooth. It will help you in trimming of excess restorative material later. The cavity preparation is completed by drying the cavity with dry cotton wool pellets.

The procedure for caries removal for one-surface cavities step-by-step

1. Place cotton wool rolls alongside the tooth to be treated.
2. Remove plaque from tooth surface with wet cotton wool pellets.
3. Dry the tooth surface with dry cotton wool pellets.
4. If necessary, make the entrance of the cavity wider with a dental hatchet.
5. Remove the carious dentine with excavators starting at the enamel-dentine junction.
6. Fracture off unsupported thin enamel with the hatchet. Make sure the enamel does not contain any carious spots.
7. Clean the cavity with wet and then dry cotton wool pellets.
8. Remove the caries near the pulp carefully.
9. Clean the cavity again with wet cotton wool pellets.
10. Check the relation of the tooth to be restored with the opposing teeth by asking the patient to bite.
11. Complete the procedure by drying the cavity with dry cotton wool pellets.

Cleaning the Prepared Cavity

In order to improve the chemical bonding of glass-ionomer to the tooth structures, the cavity walls must be very clean. It is not effective to do this with wet cotton wool pellets and therefore a chemical solvent is used. There are two possibilities:

- a dentine conditioner or tooth cleaner, especially developed for this purpose or
- the liquid supplied with the glass-ionomer itself.

The **dentine conditioner** is usually a 10% solution of polyacrylic acid. Apply one drop of the conditioner on a pad or the slab. Dip a cotton wool pellet in the drop and then clean the entire cavity and adjacent fissures for 10-15 seconds. Do this holding the cotton wool pellets with a pair of tweezers (Fig 4.3). Then, immediately, wash the cavity and fissures at least twice with cotton wool pellets, dipped in clean water.

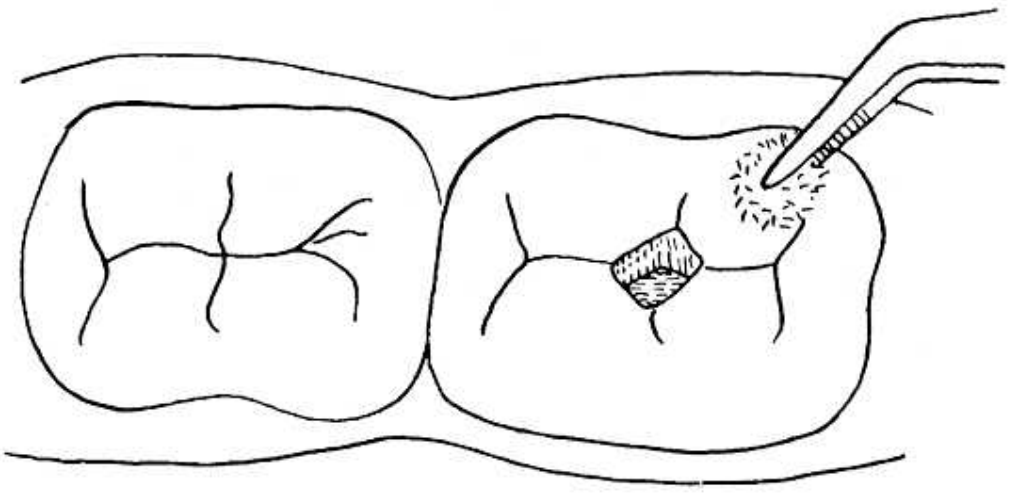


Figure 4.3
Application of dentine conditioner

The glass-ionomer liquid can be used for cleaning the cavity if it contains the same acid as is used for conditioning. Usually the liquid is too strong and needs to be diluted. This is done by placing one drop of liquid on a pad or slab. Then moisten a cotton wool pellet by dipping it in water. Remove the excess water by lightly touching the pellet against a dry cotton wool roll, a tissue or gauze. Dip the moist pellet in the glass-ionomer liquid and then use it as a dentine conditioner in the way described above.

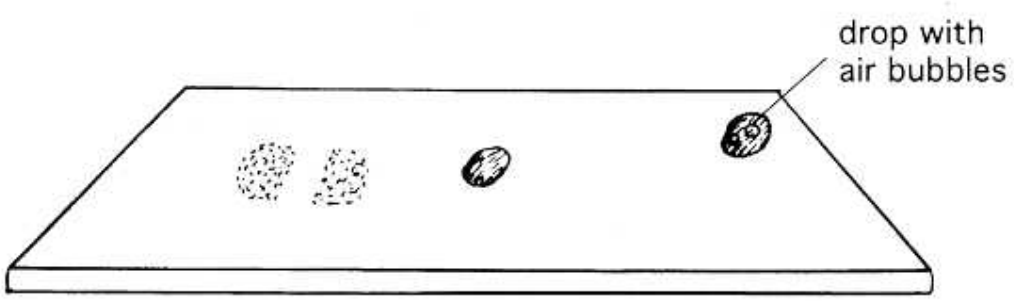
Read the manufacturers' instructions carefully as it may contain further information about the use of their product. For example, there are brands where all chemical components are in the powder, while the liquid is only de-mineralized water. The liquid would therefore not be suitable for conditioning the cavity and a special conditioner must be used.

If the cavity is contaminated with blood, stop the bleeding by pressing with a cotton wool pellet on the wound. Wash the blood away with water and dry the cavity with cotton wool pellets. Place dry cotton wool rolls on both sides of the tooth to prevent recontamination. Then apply the conditioner in the cavity as described above. If a cavity becomes contaminated after having been conditioned, it is essential to wash, clean and recondition the cavity again.

Note: It may happen that the first drop of liquid contains air bubbles. Such a drop should not be used for mixing with the glass-ionomer powder. The powder-liquid ratio would not be correct. However, if the glass-ionomer liquid is used as the conditioner, such a drop can well be used for conditioning.

It is advisable to dispense one drop for conditioning and a second drop for mixing, keeping the bottle in the vertical position between dispensing (Fig. 4.4)

Figure 4.4
Mixing pad with two drops of liquid



The Procedure for conditioning one-surface Cavities step-by-step

If manufactured dentine conditioner / tooth cleaner is used.
1. Apply one drop of conditioner on a slab or pad.
2. Dip a cotton wool pellet in the conditioner.
3. Clean the cavity and adjacent fissures with the conditioner for 10-15 seconds.
4. Wash the cavity and fissures immediately at least twice with cotton wool pellets, dipped in clean water.
5. Dry the cavity with dry cotton wool pellets.
6. Repeat procedures 3-5 if the conditioned cavity becomes contaminated with saliva and/or blood.

If the glass-ionomer liquid is used as a dentine conditioner.
1. Apply one drop of liquid on a slab or pad.
2. Dip a cotton wool pellet in clean water.
3. Remove excess of water from the cotton wool pellet by lightly touching against a dry cotton wool roll, tissue or gauze.
4. Dip the moist cotton wool pellet in the glass-ionomer liquid.
5. Follow the procedure for the dentine conditioner, as for points 3-6 presented above.

Restoring the Cavity

Make sure that the tooth is kept dry during the restorative phase. If necessary place new cotton wool rolls. An assistant is very useful at this stage, especially for mixing the glass-ionomer material.

Ensure that all necessary materials and instruments are available and ready for use. After the cavity is conditioned, washed and dried, you can start mixing the glass-ionomer. Insert the mixture into the cavity in small amounts using the blunt end of the applier/carver instrument. This will avoid inclusion of air bubbles. Push the mixture into place with the round surface of a medium excavator. Make sure the mixture goes into small cavities and under any enamel overhanging. Also place a little extra material on the adjacent pits and fissures (Fig 4.5a). Rub a small amount of petroleum jelly on the gloved index finger and press the soft restorative material firmly into the cavity and fissures (Fig 4.5b). This is called: 'the press-finger technique'. Remove the finger sideways after a few seconds. The time from the start of mixing until removal of finger should be no more than one minute.

Excess glass-ionomer material will be displaced by the press-finger technique towards the slopes of the cusps and between the cusps in the direction of buccal/lingual and proximal

surfaces. Quickly and carefully remove any excess material with a medium or large excavator.

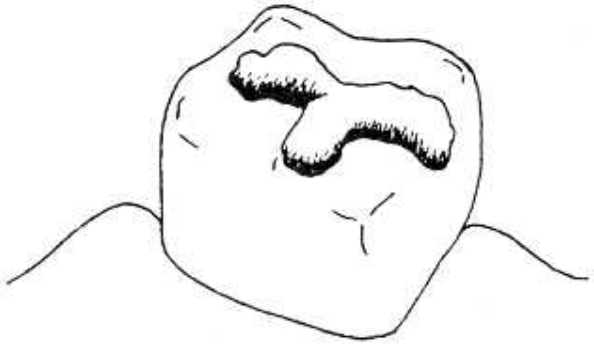
Then do not disturb the restoration during the hardening period and keep the tooth moisture free.

After about 1 to 2 minutes (depending on climatological conditions) check the bite. Place a piece of blue/red articulation paper on the restored tooth. Ask the patient to close the mouth and bite from side to side. Make sure that the patient does not bite on the cotton wool rolls. If the ART restoration is too high, blue/red spots appear. The height of the restoration can then be adjusted by scraping away some of the colored stained restorative material with the carver blade of the applier/carver (Fig 4.5c).

Finally, cover the ART restoration with a new layer of petroleum jelly. Then remove the cotton wool rolls. The restorative procedure is finished (Fig. 4.5d). Ask the patient not to eat for at least one hour.

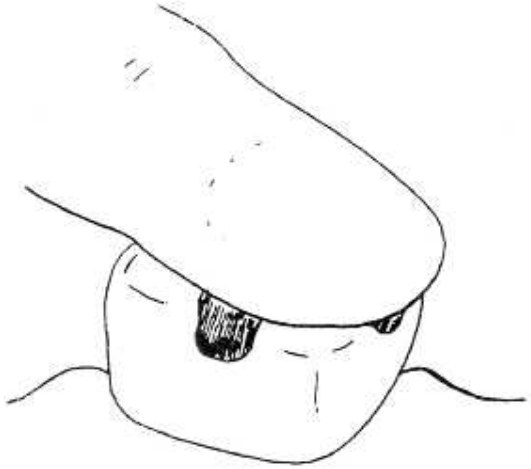
Figure 4.5
The restorative process of a one-surface cavity in various stages

a. The cavity and adjacent pits and fissures are overfilled



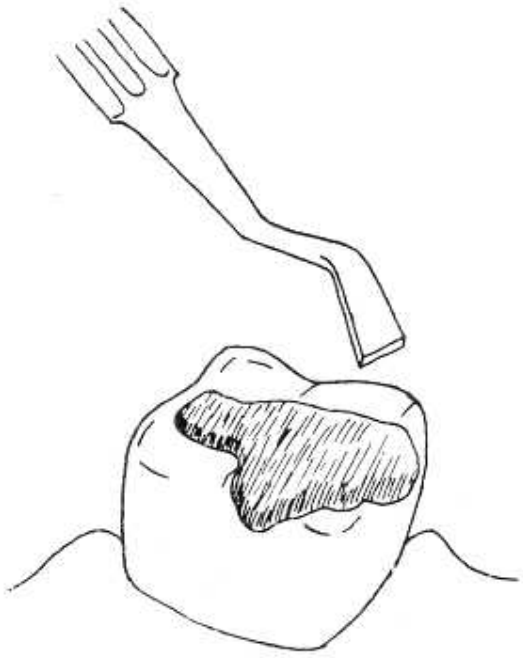
a.

b. Press the restorative material with gloved finger. Excess material is visible



b.

c. Removal of excess material by the carver blade of the applier/carver



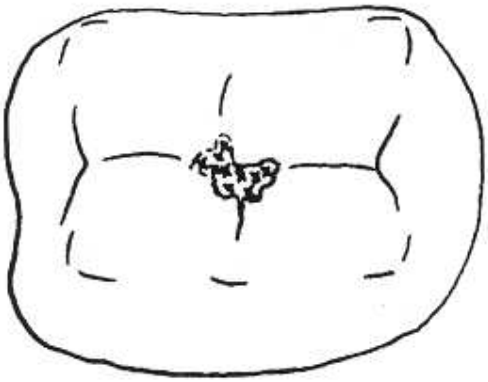
c.

The Procedure for Restoring one-surface Cavities step-by-step

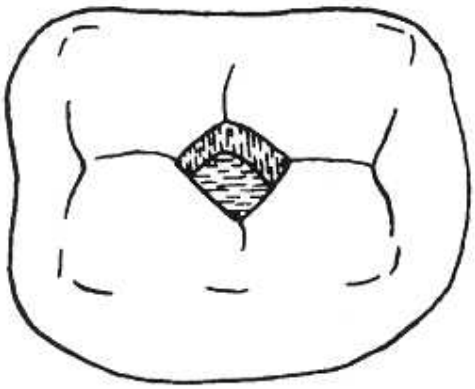
1. Check that all instruments and materials are available and ready for use.
2. Ensure that the tooth is kept dry during the restoration phase.
3. Mix restorative material according to earlier description (20-30 seconds).
4. Insert the mixture in small amounts into the cavity and into the adjacent fissures, using the blunt blade of the applier/carver. Use round surface of a medium excavator to push the mixture into deeper parts of the cavity and under any overhanging.
5. Rub some petroleum jelly on the gloved index finger.
6. Place the index finger on the restorative material, press and remove finger sideways after a few seconds.
7. Remove visible excess of glass-ionomer with a medium or large excavator.
8. Wait 1-2 minutes till the material feels hard, whilst keeping the tooth dry.
9. Check the bite using articulation paper and adjust the height of the restoration with the applier/carver if needed.
10. Apply a new layer of petroleum jelly.
11. Remove cotton wool rolls.
12. Ask the patient not to eat for at least one hour.

Figure 4.6
A cavity is restored and the adjacent fissures are sealed with glass-ionomer at the same time.
This is called a
'sealed restoration'

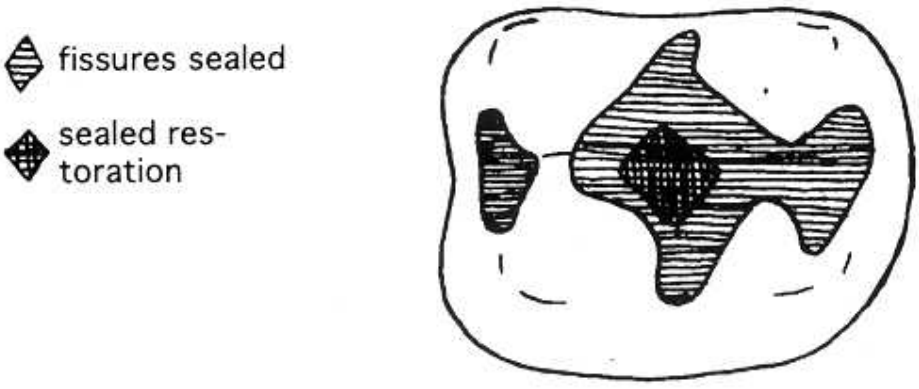
a. Caries in occlusal surface of molar



b. prepared cavity ready for applying ART restoration material



c. Cavity filled.



Chapter 5 - Restoring Multiple-Surface Cavities Using ART

This chapter describes the step-by-step stages and the instruments needed for placing ART restorations for treatment of multiple-surface cavities.

Preparing the Cavity

Basically, two types of multiple-surface cavities exist, those in front teeth and those in premolar/molar teeth. Those in front teeth are usually not very large, but multiple-surface cavities in premolars/molars vary and can be large.
In principle, the same stages described for one-surface cavity preparation and restoration have to be followed for multiple-surface cavities. A summary of the procedures is presented below.

It is usually not necessary to open the cavity. Start excavation at the enamel/dentine junction, then remove caries towards the pulp (Fig. 5.1). Ensure that the cavity outline is smooth and free of caries, particularly the outline in the proximal surface. Do this by placing the dental hatchet on the enamel close to the end of the cavity (Fig. 5.2). Then push gently down. Small pieces of enamel will chip off. Smoothen the outline further by scraping the dental hatchet over the enamel. Make sure that the dental hatchet is well supported by your fingers.

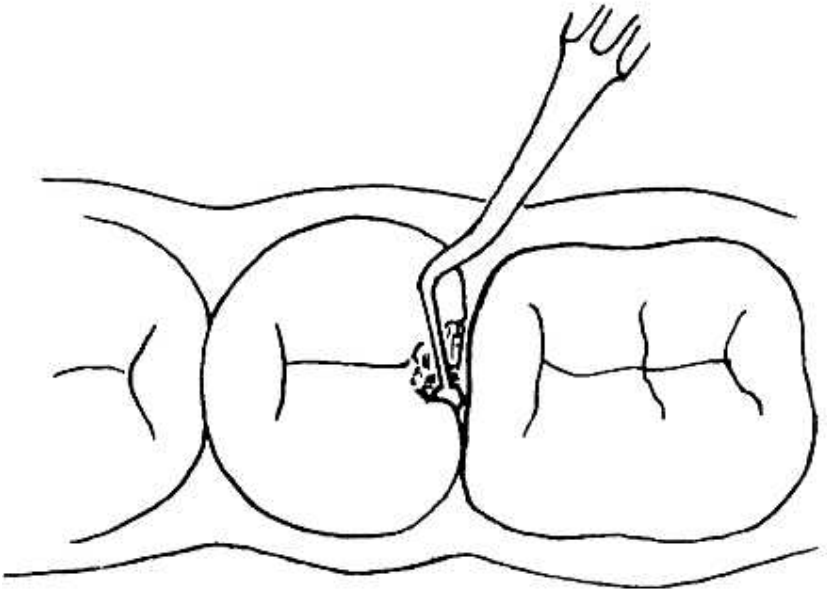


Figure 5.1
Using the spoon excavator to remove carious dentine in a multiple-surface cavity

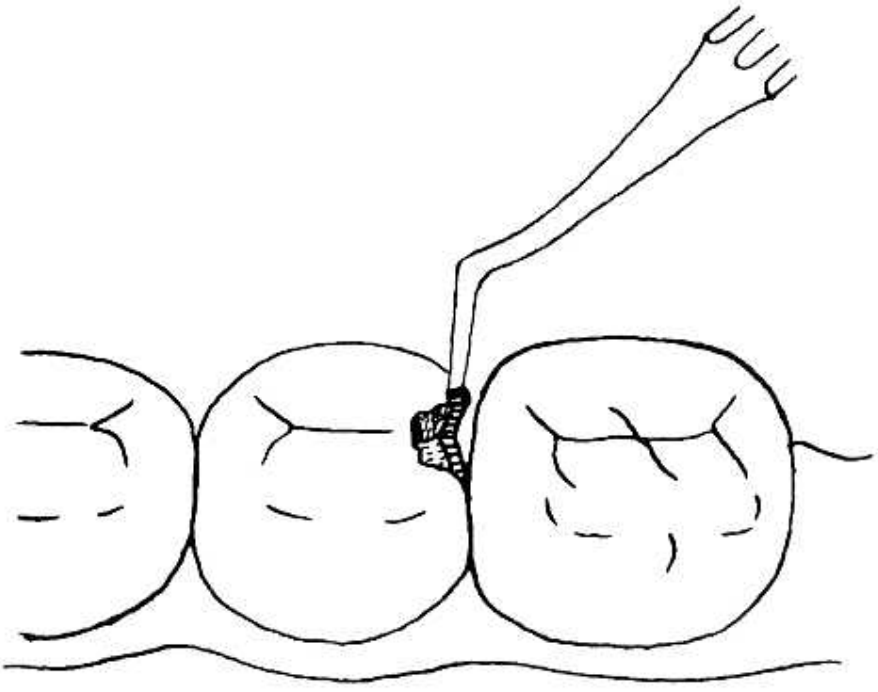


Figure 5.2
The position of the dental hatchet for smoothing the proximal outline

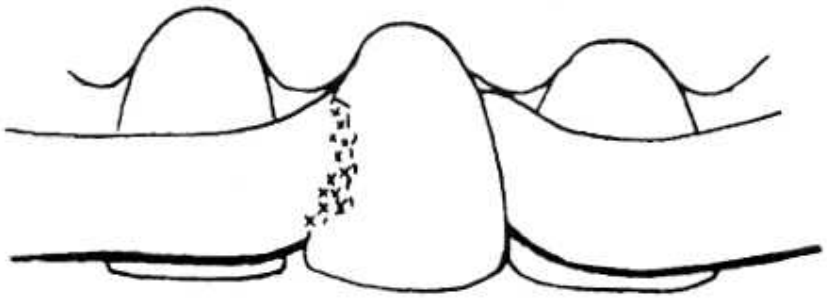
Restoring the Cavity

Anterior teeth

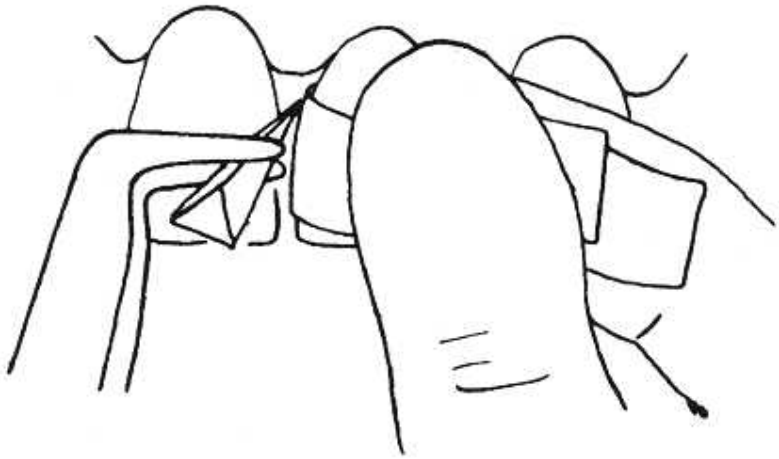
Extra attention is needed when restoring large cavities to ensure that the restoration has the correct shape. A step by step description of the restorative procedure in anterior teeth is given in (Fig. 5.3).

Figure 5.3
Restoring a proximal surface cavity in various stages

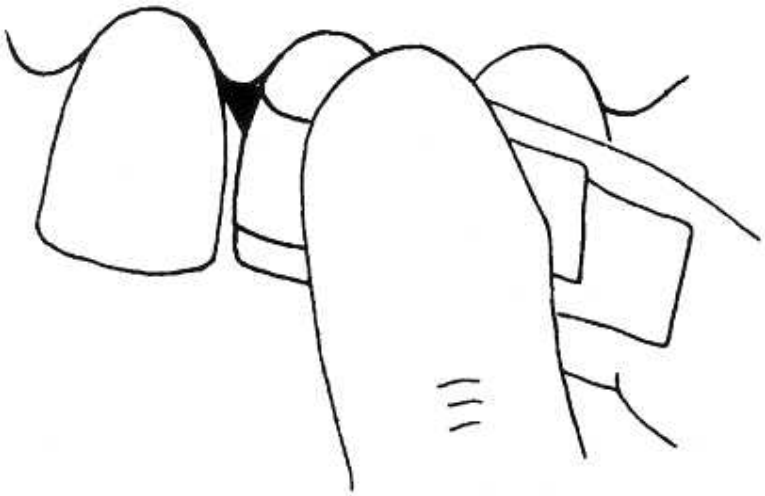
a. Positioning of the strip between the teeth



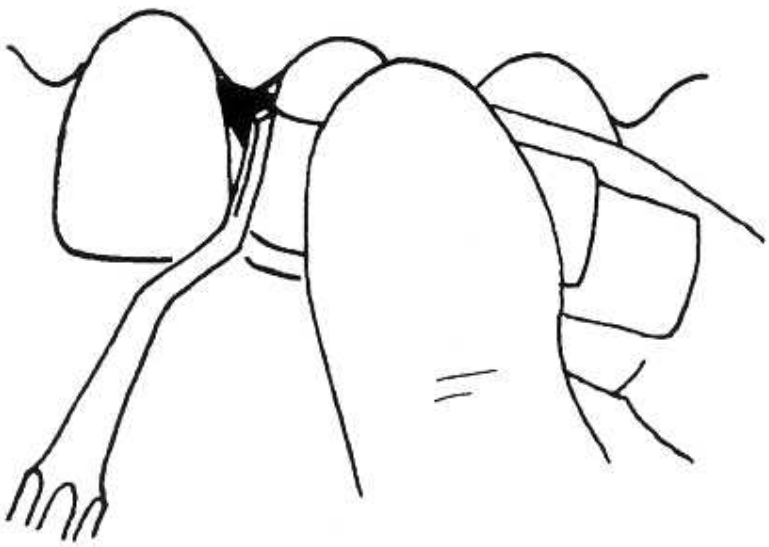
b. Insertion of a wedge



c. The strip is pulled around the tooth while the mixture is setting



d. A straight instrument is pressed against the strip to shape the restoration



The Procedure for Restoring multiple-surface Cavities in Anterior teeth step-by-step

1. Work in a dry environment using cotton wool rolls. Replace these as required.
2. Clean the cavity and ensure that the outline is smooth and free of caries.

Place a plastic strip between the teeth and use this to make the correct tooth contour of the proximal surface.

4. Insert a soft wood wedge between the teeth just at the gum margin to keep the plastic strip firmly in position.
5. Condition the cavity as described for the one-surface cavity.
6. Mix the glass-ionomer as described before and insert it into the cavity until it is **slightly** overfilled.
7. Hold the strip tightly with the index finger on the palatal side of the tooth. Wrap the strip firmly around to the buccal side to adapt the restorative material well into the cavity. Hold the strip with the thumb on the buccal side for 1-2 minutes until the material has set firmly.
8. Remove the strip and wedge, and cover the restoration with petroleum jelly.
9. Remove any excess material with the carver, check the bite with articulation paper and apply another coat of petroleum jelly.
10. Remove cotton wool rolls.
11. Ask the patient not to eat for one hour.

Posterior teeth

Restoring multiple-surface cavities in primary molars

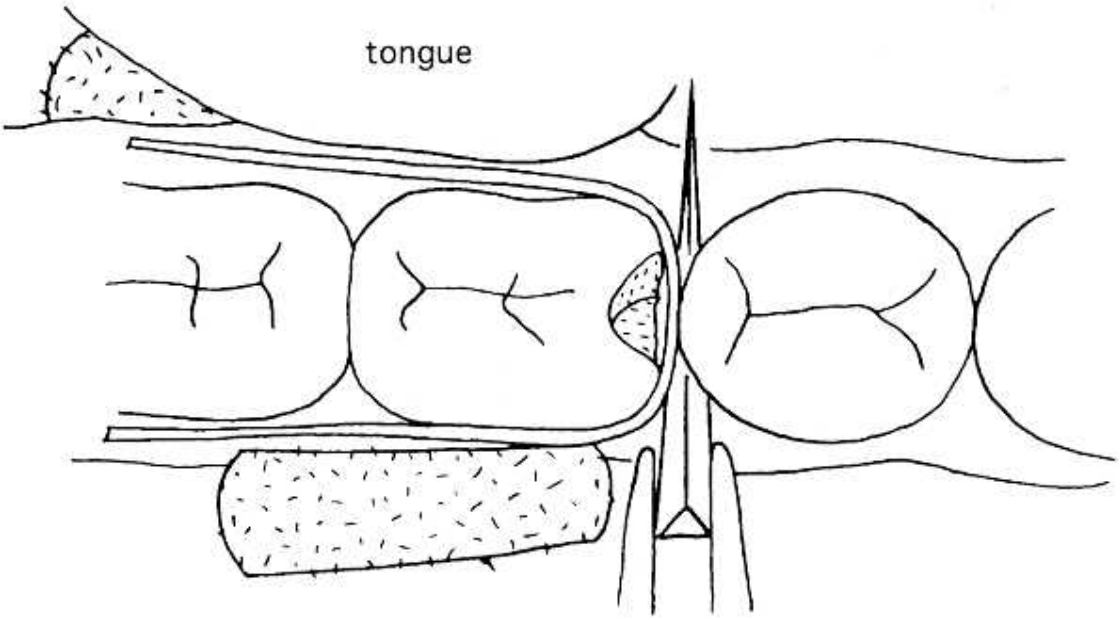
In the primary dentition it is not always necessary to restore the proximal contour of the tooth completely. Much depends on the size of the cavity and the length of time the tooth will still remain in the mouth. Large proximal lesions in the primary dentition can be treated by flattening off proximal surfaces.

Restoring multiple-surface cavities in posterior permanent teeth

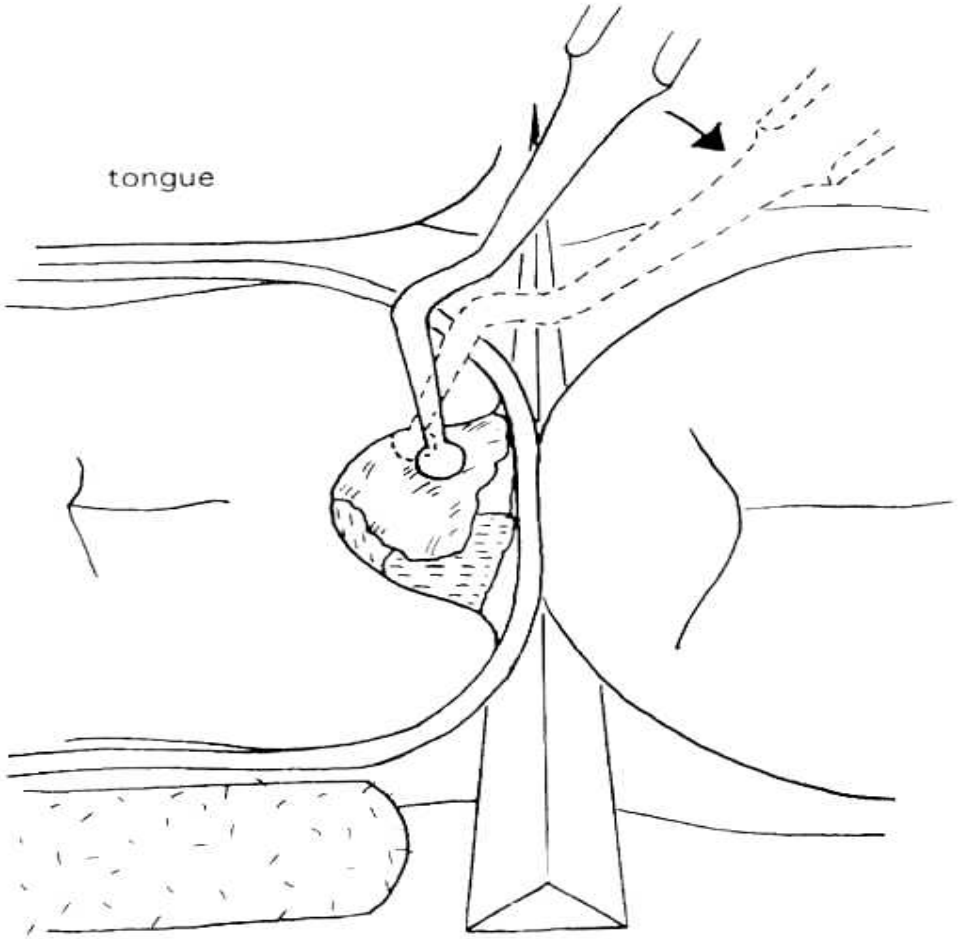
Multiple-surface cavities of posterior permanent teeth can also be restored using a plastic strip, which is held, in position by a wedge (Fig. 5.4). Try to avoid flattening off proximal surfaces. Before the strip is fitted, ask the patient to close the jaws together so that you can decide how much of restorative material should be trimmed later.

Note: Large cavities need more restorative material than small cavities and, therefore, one drop of liquid and one scoop of powder may not be enough. Then use two drops and two scoops. If this still does not provide enough material, prepare a second mixture and insert on top of the first mixture. Make sure that the first mixture has not been contaminated with saliva or blood in the meantime. If this has happened, the first mixture should be allowed to become hard. Cut back the contaminated surface by a millimeter. Then clean, wash and dry the surface of the first mixture and any remaining uncovered dental tissues. Then insert the second mixture and complete the restorative procedure.

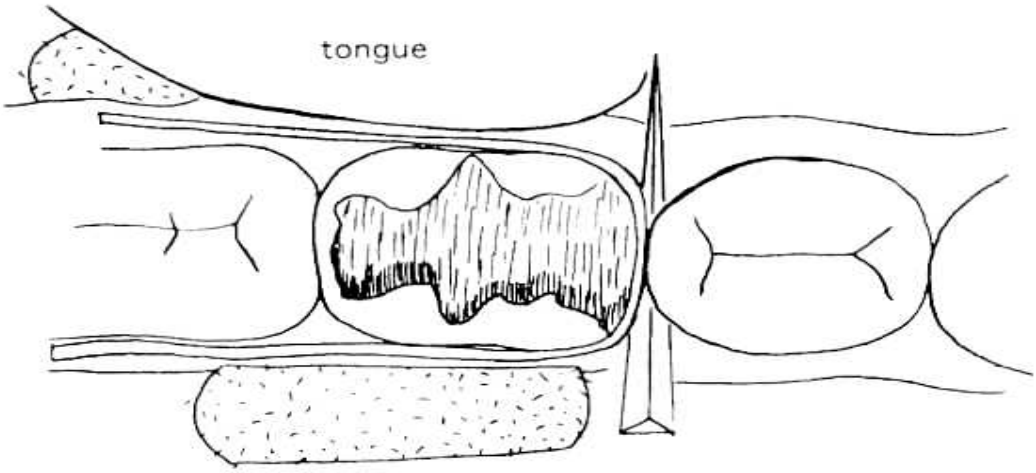
Figure 5.4 Restorative procedures for multiple-surface cavities in posterior teeth



a. Plastic strip and wedge in position

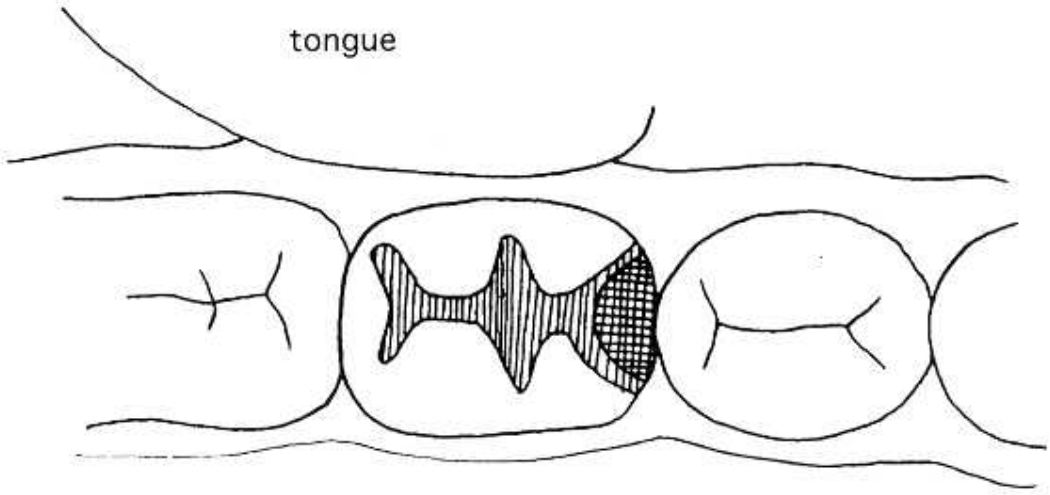


b. Restorative material pushed into place under unsupported enamel



c. Slightly overfilled sealed restoration

d. Finished sealed restoration



The procedure for restoring multiple-surface cavities in posterior teeth step-by-step

1. Work in a dry environment using cotton wool rolls. Replace these as required.
2. Clean the cavity and ensure that the outline is smooth and free of caries.
3. Place the strip between the teeth. Insert a wedge to support the strip under the contact point at the gum margin.
4. Condition the cleaned cavity and adjacent fissures as described for the one-surface cavity.
5. Fill the cavity completely with glass-ionomer. Insert material into corners and under unsupported enamel first. Make sure that there is enough restoration material to fill the entire cavity and the adjacent fissures. If material mixed is not enough to fill the cavity, mix a new lot and insert a second filling on top of the first material (avoid contamination with saliva or blood).
6. Handle the plastic strip as explained for cavities in anterior teeth.
7. Try to place a petroleum jelly coated, gloved index finger on top of restoration and press slightly for a few seconds. Remove finger sideways.
8. Remove excess glass-ionomer with a medium or large excavator. Leave the restoration to harden for 1-2 minutes, then remove wedge and strip.
9. Check bite with articulation paper.
10. If necessary, remove excess restorative material with the carver.
11. Check that the cusps of the opposite tooth will not destroy the restoration. It is better to have no occluding contacts than a contact that is too high.
12. Trim the proximal margins with the carver and apply new petroleum jelly.
13. Check the height of the restoration again with articulation paper and apply petroleum jelly if necessary.
14. Remove cotton wool rolls.
15. Advise the patient not to eat for at least one hour.

Chapter 6 - Glass-Ionomer Used as a Sealant

Besides being used as a restorative material, glass-ionomer can also be used as a sealant. The ART approach uses the same glass-ionomer for both restorations and sealants. This chapter describes the rationale, indications and procedures for using glass-ionomer as a sealant.

Rationale

It is not always easy to see early dental caries. Its progression can be rapid, particularly in young people who have already untreated cavities and/or restorations. If nothing is done, early dental caries can develop to a cavity in less than 1 year.

Sealing pits and fissures with glass-ionomer can control dental caries and prevent it from occurring. The presence and viability of microorganisms under pit and fissure sealants has been investigated. It has been shown that when the sealant remains intact, the number of viable microorganisms left beneath the sealant decreases with time. The destructive activity of the remaining bacteria is reduced, leaving the bacteria incapable of causing tooth destruction. This is logical since remaining bacteria are now cut off from their source of nutrients. There is convincing evidence that pit and fissure sealants are capable of arresting the carious process.

Even when glass-ionomer sealants have been partly or completely lost, there is usually a benefit to the patient because the fluoride released from the material will have made the enamel harder.

Indications

As glass-ionomer sticks chemically to enamel, it is useful as a sealant. It also releases fluoride into the enamel and this may stop further development of caries. Experience has shown that sealants of glass-ionomer remain in the deeper pit and fissures that are most at risk for decay. In contrast, sealants may be lost rather quickly in shallow pits and fissures.

Therefore, only place sealants in deep pits and fissures, which show signs of early tooth decay.

Do not place sealants in pits and fissures, which are deep and colored dark. The dark color is usually a sign that caries has come to a halt. It can, however, also be a superficial stain. You only should place a sealant when the dark colored pits and fissures are surrounded with a clear whitish discoloration. The latter is a sign of early tooth decay.

Procedures

Place the sealant only in the pit and fissures. **Take care not to cover the cusps of the tooth.**

1. Isolate the tooth with cotton wool rolls. Keep the treatment area dry.
2. Clean the surface from debris with a cotton wool pellet dipped in water.
3. Gently remove debris from deepest parts of pit and fissures with an explorer.
4. Apply dentine conditioner or diluted glass-ionomer liquid into the pits and fissures for 10-15 seconds.
5. Immediately wash the pits and fissures, using wet cotton wool pellets to clean off the conditioner. Wash 2-3 times.
6. Dry the pits and fissures with cotton wool pellets.
7. Mix the glass-ionomer and apply it in all pits and fissures with the blunt blade of the applier/carver. Overfill slightly.
8. Rub some petroleum jelly on the gloved index finger.
9. Put the index finger on the mixture, press and remove finger sideways after a few seconds.
10. Remove visible excess of mixture with a large excavator.
11. Wait 1-2 minutes till the material feels hard, whilst keeping the tooth dry.
12. Check the bite using the articulation paper and adjust the amount of sealant with the carver if needed.
13. Apply a new layer of petroleum jelly.
14. Remove cotton wool rolls.
15. Ask the patient not to eat for at least one hour.

Chapter 7 - Monitoring ART Restorations and Sealants

Careful monitoring of restorations and sealants is important. Methods for monitoring and ways to replace or repair restorations or sealants that have been judged to be defective are briefly described in this chapter.

Monitoring Restorations and Sealants

ART can be used both in the dental clinic and in communities where no clinic exist. For example, ART restorations and sealants can be performed in schools and health centres in urban and remote areas.

No restoration or sealant, irrespective of the material used, lasts forever. Some restorations will last for many years, others may fail earlier. For ART restorations always follow the instructions in this manual to obtain the best results. It will reduce the number of restorations and sealants which fail. Faulty restorations and sealants need to be identified and repaired. Keeping records of the kind of treatment which has been performed will help in understanding how well people have been treated. Monitoring is more easily undertaken in schools than in clinics, since students/pupils will normally be available when you visit the school.

When to Monitor

It is useful to collect information about any pain experienced and whether ART was accepted. Therefore, ask patients about pain felt during and after treatment, and their overall satisfaction within a period of 4 weeks after being treated. As any serious problems tend to occur soon after the treatment is finished, the first clinical evaluation could take place after half a year. Further evaluations can be planned on an annual or biannual basis depending on factors such as expected caries development, length of time students stay at school and the possibility of seeing the individuals again (remote areas).

What to do with failed or defective Sealants and Restorations

Failed or Defective Sealant

A sealant appears to be defective or has disappeared completely. Examine the tooth carefully for signs of caries. If the surface is hard, leave it alone. If the surface is carious, reseal or make a small restoration. What to do depends on the extent of the defective sealant or of the caries present. Resealing is done in the same way as described for sealing in chapter 6. If a cavity continues to extend under an old sealant, follow the instructions for the one-surface cavity procedure in chapter 4.

Failed or Defective Restoration

A restoration may not be acceptable or unsatisfactory anymore for several reasons:

1. it is completely missing,
2. a large part of it has broken away,
3. the restoration is fractured,
4. much of the restorative material has worn away,
5. caries has developed at the restoration margin or elsewhere on the tooth surface.

1. Restoration is completely missing

Some of the reasons for failure could be:

- contamination with saliva or blood during the restorative procedure,
- mix of material was too wet or too dry,
- not all the soft caries had been removed,
- thin undermined enamel had been left behind, and this later broke off.

Whatever the reason, clean the cavity completely, apply dentine conditioner and refill the cavity according to the description in chapter 4 or 5.

2. Part of the Restoration has Broken away

It is probable that the restoration was too high or air bubbles were trapped in the material during placement of the restoration. Whatever the reason, clean the tooth surface and/or remaining restorative material with an explorer or small excavator and wet cotton wool pellets first, before conditioning the entire surface and material. Fill the gap with a new mixture of glass-ionomer and ensure that the restoration is not too high.

3. The Restoration has fractured

This most commonly happens in a multiple-surface restoration which was too high. The way to repair it very much depends on the location of the fracture line and the mobility of the fractured part. If the fractured part is loose and can be removed, repair the gap as described under point 2. However, if the fractured part cannot be removed, repair through ART is not possible and traditional treatment using a drill is needed.

4. The Restoration has worn away

Possible reasons for this are the patient eats very hard food frequently, the patients clenches his/her teeth frequently or the mixture had been too wet or dry. It may take years, but it is possible that so much material has been lost that the restoration should be rebuilt. Ensure that all the surfaces of the tooth and the remaining restoration are clean and free from soft tooth tissues. Apply dentine conditioner over the glass-ionomer and the cavity walls. Place a new layer of glass-ionomer on top of the old one. Finish the restoration as described in chapter 4.

5. Caries has Developed in the adjacent Fissures or Surface

Remove the soft tooth tissues. After all decay has been removed, clean and fill the new cavity adjacent to the restoration according to the standard procedures.

Chapter 8 - ART: What not to Forget

Restoration of decayed teeth is part of a total package of oral care which should always be based on preventive measures, health education and health promotion activities.

Prevention

Prevention of diseases is most important for developing and maintaining good health. Unfortunately, prevention alone is not always sufficient. If people have a disease, they like to be cured because the disease bothers them. After being cured people may be willing to listen to preventive advice.
That means prevention and cure should go hand in hand. In other words, neither prevention nor cure should be presented to the people separately.

This manual emphasises ART **as a combined preventive and curative oral care procedure.**

Treating dental caries using the ART approach without emphasis on preventive measures is a job only half done. It is important to explain to people how they can prevent dental caries from affecting other teeth. Prevention of dental caries is based on the following elements:

1. removal of plaque,
2. counselling on proper diet,
3. application of fluorides,
4. application of antimicrobial agents.
5. application of sealants

Many people are not aware of how to take care of their teeth properly and have come to you for the treatment of a painful tooth. What can you do after the tooth has been treated The answer is: give oral health education. Instruct the patient how best to take care of the teeth. If toothpaste with fluoride is available and affordable, advise them to use it. Inform them about food which is good and which is bad for teeth. Apply fluorides, sealants or antimicrobial agents when indicated and available.

1. Removal of Plaque

Tooth cleaning not only helps in preventing dental caries, it is essential in preventing gum diseases. Proper tooth cleaning is very important but it may also be difficult for some people. They need clear instructions and demonstrations: Clean your teeth either by tooth brush or chewing stick at least once a day, preferably twice. If only once a day is a realistic goal, then advise them to clean before going to bed. The teeth are thus plaque free for a long period of time. A good cleaning once a day is better than a poor job several times a day.

2. Diet Counselling

People should eat a well-balanced diet, high in fibres and rich in vitamins. A lot of luxury and convenience foods and drinks contain sugars. These and the refined table sugars are the main reason for getting tooth decay. Eating sugar in small quantities and only two or three times a day, will limit the harm caused to the teeth.
But, if a lot of sugar is consumed, on many occasions over the day, dental caries is very likely to develop.

If this happens daily over a long period, it is almost certain that cavities will be formed.
If sugary foods or drinks are to be taken, people should be advised to do this at a particular moment of the day. For example, before a meal, not after. Also inform them about food that is low in sugar.

3. Use of Fluorides

Fluorides make the enamel stronger. It stops the growth of bacteria which causes dental caries and helps in stopping early tooth decay. Fluoride is often incorporated in toothpaste. So toothpaste with fluoride should be recommended for cleaning teeth. Fluoride gel or varnish is recommended for tooth surfaces which are not indicated for sealants. For example the buccal/palatal/lingual smooth surfaces.

Fluoride mouthrinsing reduces dental caries. This can be done at school. Try to find out whether it is possible to introduce fluoride mouthrinsing programmes at schools.

4. Use of Antimicrobial Agents

There are many antimicrobial agents but fluoride is most accepted. The next best known antimicrobial is chlorehexidine which is available as a solution, a gel and as a varnish. However, there is some reservation against the use of chlorehexidine amongst professionals. The reasons are to do with the bad taste, the chance of staining the teeth black and the fact that its effect on preventing tooth decay is not conclusive.

Consult dental professionals in your region regarding the use of antimicrobial agents.

Chapter 9 - List of Essential Instruments and Materials

In order to carry out the Atraumatic Restorative Treatment approach in the field, the following essential instruments and materials are required.

Instruments

Mouth mirror
Explorer
Pair of tweezers
Dental hatchet
Spoon excavator, small
Spoon excavator, medium
Spoon excavator, large
Applier/carver
Glass slab or paper mixing pad
Spatula

Materials

Cotton wool roll
Cotton wool pellet
Clean water
Glass-ionomer restorative material liquid, powder and measuring spoon
Dentine conditioner
Petroleum jelly
Wedge
Plastic strip
Articulation paper

Other

Examination gloves
Mouth mask
Operating light
Operation bed / headrest extension
Stool
Methylated alcohol
Pressure cooker
Instrument forceps
Soap and towel
Sheet of textile
Sharpening stone and oil