THE MODERN PRACTICE OF TOOTH-EXTRACTION

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THE MODERN PRACTICE OF TOOTH-EXTRACTION

BY

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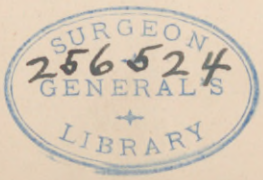

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THIS BOOK IS AFFECTIONATELY DEDICATED
TO MY PARENTS

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PREFACE

I have prepared this book primarily for the general practitioner and student, and have purposely omitted a description of the technique of removal of impacted and unerupted teeth, because I believe that their removal is an oral surgical operation, of sometimes serious dimensions, and that unless the general practitioner is especially equipped and trained for operations of this type, it would be wiser to refer these cases to a specialist. As for the discussion of the technique of anæsthesia, there are so many splendid books devoted to this subject, that it would be superfluous in a work of this kind.

The whole important subject of tooth extraction seems to have been somewhat neglected in the past, so I have tried to make this a text for the general dentist—although the oral specialist will find points of interest in it as well.

I have dwelt at some length upon the pre-operative care of the patient, and methods of observing the patient's physical condition, because very often

a successful outcome to an operation depends upon a full consideration of these subjects.

My belief that the after-care of the patient and wound is as important as the operation itself has led me to take up this phase fully.

This book is based solely upon my own experiences and ideas and the operations herein described have been evolved by me, although perhaps there are others who have thought of and performed them in the same way.

L. R. C.

New York City.

THE MODERN PRACTICE OF TOOTH-EXTRACTION

CHAPTER I

INTRODUCTION—ANÆSTHESIA—ARMAMENTARIUM
STERILIZATION

Introduction

In order to efficiently remove teeth with a minimum amount of trauma to the tissues, a definite technique must be acquired. The placing of the beaks of the forceps over the gums and alveolar process, and crushing these tissues, is brutal and not to be countenanced. With a correct understanding of the anatomy of the teeth and jaws, proper instrumentarium and anæsthesia, a surgical technique can be evolved that will place the extraction of teeth on the same plain with any other minor surgical operation.

The removal of tonsils is attended with all the preparation of an operation, and yet the extraction of some teeth is much more difficult, and as equally precarious as any tonsillectomy. Why then should not the removal of teeth be given its just place in the realm of minor surgery?

Anæsthesia

In the opinion of the writer, local anæsthesia is the one of choice. There is scarcely a case where it cannot be used. With the use of procain we are assured of a safe anæsthesia, and a lengthy enough one to perform our operation carefully, and with the coöperation of the patient. Most of the mutilating results in tooth extraction occur under the use of general anæsthetics. The excuse that some people are too nervous for local anæsthesia is a poor one, because by proper pre-operative treatment, and gentle handling, the nervous patient is changed to a calm one. In young children there may be some difficulty in controlling them, and in these cases only is general anæsthesia indicated. When we consider the magnitude of the operations performed by Braun and others, often on debilitated patients, we can readily understand the advantage of this method of anæsthesia, and the feasibility of its use in so comparatively a simple operation like tooth extraction.

In dental surgery local anæsthesia can be divided into infiltration anæsthesia and conduction anæsthesia. The choice of either of these two methods depends upon the character of the case to be operated upon. In the greater majority of cases, in the upper jaw, infiltration anæsthesia will suffice. For

the lower posterior teeth conduction anæsthesia is the one of choice. The lower anterior teeth can be very satisfactorily anæsthetized by the infiltrative method. Infiltration anæsthesia should not be administered with a short needle, plunged through the periosteum to the bone, and a great deal of pressure exerted. An inch steel needle, about 26 guage, is introduced into the muco-buccal fold above, or below, as the case may be, the tooth to be extracted. It is advanced toward the apex of the tooth, and about 2 c.c. of the solution deposited. A few drops on the palatal or lingual surface will complete the anæsthesia. If it is deemed necessary to use conduction anæsthesia, the following injections are made: for the upper posterior teeth, including the second bicuspid, the tuberosity and posterior palatine injections, with slight infiltration over the second bicuspid; for the upper anterior teeth and first bicuspid, the infra-orbital and anterior palatine injections. Occasionally, it is necessary to infiltrate palataly about the first bicuspid, and labially above the central incisor, in order to block sensation from anatomosing nerves. The lower molars, bicuspids, and anterior teeth up to the median line are blocked by the mandibular injection, with labial infiltration about the anterior teeth. Frequently, the long buccal nerve has to be blocked, and this is accomplished

by inserting the needle into the muco-buccal fold opposite the lower first molar. The mental injection is rarely used. For a more detailed description of the technique of these injections, the reader is referred to larger works on local anæsthesia in the oral cavity.

Instrumentarium

The minimum amount of instruments compatible with efficiency is all that is required. Some men have become accustomed to certain types of instruments, and obtain good results from their use, and to these, they should be loyal. However the anatomy of the tooth to be extracted, and its position in the mouth, must be considered in selecting the forceps. There are a lot of freak forceps made, supposedly to facilitate our operations. These are only fads to catch the eye of the dentist, and increase the sales of the manufacturer, and should be relegated to the discard. The forceps that have proven most valuable to me are (Fig. 1):

For upper 1st and 2nd molars..S. S. W. No. 53, right and left
For upper third molars .....S. S. W. No. 10
For upper anterior teeth and bicuspids.S. S. W. No. 32.
For upper roots.....S. S. W. No. 65
For lower molars..An English pattern forceps,

so fashioned that the teeth can be grasped while standing in front of the patient.

For lower bicuspids and anterior teeth. . S. S. W. No. 63 or 151

For lower roots ..... S. S. W. No. 151 or 63

Fig. 1.—The author's selection of forceps. (1) S.S.W. No. 151, (2) English pattern forceps for lower molars, (3) S.S.W. No. 63, (4) S.S.W. No. 32, (5) S.S.W. No. 53R, (6) S.S.W. No. 53L, (7) S.S.W. No. 10.

The only elevator I use, both for upper or lower roots, is the S.S.W. No. 12C.

The following are the accessory instruments, dressings and drugs:

1. Syringe for local anæsthesia, fitted with the appropriate needle.
2. Scalpel
3. Lance
4. Periosteal elevator
5. Gum scissors
6. Two narrow chisels

7. Mallet
8. Tissue forceps
9. Narrow beaked rongeur forceps
10. Broad-beaked rongeur forceps
11. Three sizes of curettes
12. Fine haemostats
13. Needle holder
14. Suture material. Either fine black silk, No. 00 or dermal suture.
15. A 10 c.c. irrigating syringe fitted with a blunt needle. The ordinary Luer syringe is very satisfactory for this purpose.
16. 2 c.c. glass Luer syringe for hypodermic medication.

Dressings

Gauze wipes
½-inch and inch iodofrm gauze strips
One-inch roller bandage

Drugs

1. Churchill's Tr. of Iodine
2. Tr. of iodine and ether, equal parts, after the formula of Dr. Ivy
3. An ounce bottle of adrenalin chloride
4. Adrenalin chloride in ampoules for injection
5. Ampoules of camphor in oil
6. Strychnine sulphate gr. 1/60th tablets.
7. Nitro glycerine gr. 1/100th tablets
8. Morphine sulphate gr. 1/8th tablets
9. Aromatic spirits of ammonia

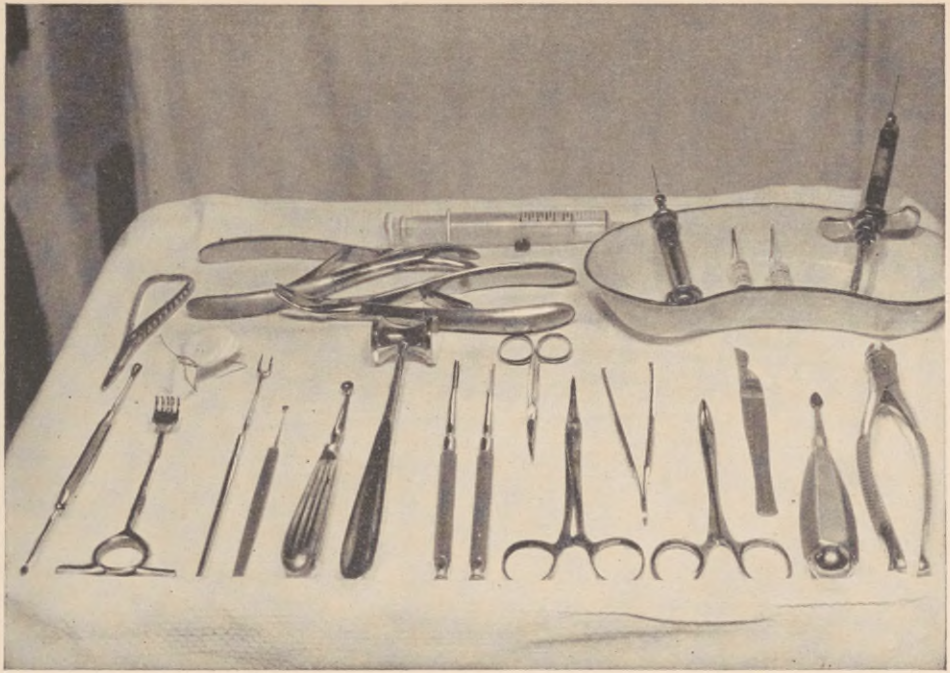

Fig. 2.—Operating tray prepared with all necessary instruments. Note small hypodermic syringe, with ampoules of adrenalin chloride 1-1000, and camphor in oil, in readiness for emergencies.

10. Normal saline solution
11. Alcohol (grain)
12. Triple bromides of Burrowes Welcome & Co.
13. Novocain powder
14. White and mentholated vaseline
15. 10% solution of nitrate of silver
16. Peroxide of hydrogen
17. A solution of iodoform 1 oz. and collodion 7 oz.

While all these instruments are not necessary in the average extraction, nevertheless, if an emergency arises, their presence and use is indispensable. The drugs should be kept where they can readily be reached, and it is my practice to have the small glass hypodermic syringe, together with the stimulants, on the operating tray. (Fig. 2.)

Sterilization

While sterilization does not have to be elaborate, it should be thorough. Under this heading, we will discuss the personal care taken by the operator, care of the operative field, and sterilization of the instruments and dressings.

Personal Care Taken by the Operator.—In operating within the mouth, it is hardly practical to wear rubber gloves. Tactile sense and free digital manipulations are necessary, and unless a man has become accustomed to the use of gloves, he will be

greatly hampered. If the patient is known to have syphilis or if there are suspicious looking lesions in the mouth, and there is no time to have a Wassermann test performed, the operator should wear rubber gloves, but this is done more as a protection to himself than to the patient. Gloves can be sterilized in several ways. They may be immersed in a solution of bichloride of mercury, 1-1000, and then rinsed in sterile water prior to the operation. They also can be boiled, or placed in the auto-clave. The simplest and safest method is to boil them in the sterilizer, dry them between the folds of a sterile towel, and then powder them with sterile talcum powder.

The hands and forearms should be scrubbed with the tincture of green soap, and the nails cleaned with an orange wood stick, and kept short. It is advisable to keep the hand brushes and the orange wood sticks in an antiseptic solution, such as bichloride of mercury, 1-5000.

The short-sleeved, long white gown is to be worn by the operator, in preference to the customary short white coat. A sterile towel can be pinned to the front of the gown and changed for each operation.

Sterilization of the Operative Field and Dressing the Patient.—It is not possible to thoroughly steril-

ize the oral cavity. Nature, however, has conferred a peculiar immunity upon the tissues of the mouth that makes them fairly resistant to infection. We can nevertheless try to render the operative field as sterile as possible, without using drugs that are caustic to the tissues. The mouth should first be rinsed with an antiseptic. A solution made up of equal parts of peroxide of hydrogen and water is a most satisfactory mouth-wash. If the operation is not urgent, and the mouth is particularly dirty, removal of the tartar and polishing the teeth should first be done, especially if we expect to suture or perform any kind of flap operation.

The tissues themselves are first painted with the tincture of iodine. Dr. Ivy recommends a 3½ per cent solution made up of equal parts of the ordinary tr. of iodine and ether. The claim for this solution is that it dries quicker, and is not caustic. I have been in the habit of using Churchill's Iodine with good success, and have not found it to be deleterious to the tissues. However, it is well to bear in mind to use only fresh iodine solutions. After the iodine, grain alcohol is applied. Iodine has a tendency to darken the tissues, especially Churchill's Iodine, and obscure our operative field. Alcohol removes this stain. Another reason for the use of alcohol is to prevent any possible caustic action from the iodine.

There are some patients whose tissues are susceptible to the action of this drug. In the vast percentage of cases we are ignorant of this fact, so that an application of alcohol following the iodine, will often prevent after-annoyance. The patient is covered with sterile towels or a sterile cover that extends below the knees. The hair also is draped with a sterile towel.

Sterilization of Instruments.—All instruments, glass, and enamel ware, are to be boiled for 15 minutes, prior to the operation. This includes sharp cutting instruments, such as scalpels, chisels and scissors. There is no method of sterilization as safe as boiling. To prevent rust, a pinch of bicarbonate of soda, or the plain washing soda, can be added to the water. Knives, scissors, or chisels, if found to be dull, are first sharpened on an arkansas stone, washed off, and the blades, or cutting edges, wrapped in cotton or gauze. They are then placed in the sterilizer to boil. The cotton or gauze will prevent the blades from becoming dull.

Suture materials are also boiled. Several needles are threaded, and the needles passed through a small piece of gauze, the thread or horse-hair, as the case may be, wound about the gauze. Care must be taken not to entangle the material.

Sterilization of the hypodermic syringe depends

upon the type used. All glass syringes of the Luer type are boiled. If the Fischer syringe is used, it is kept in a 70 per cent alcohol-glycerine solution. It is my custom to use a 3 c.c. Fischer syringe. This is kept in a container filled with a solution of alcohol 70 parts and glycerine 30 parts. The syringe, prior to using, is washed out thoroughly with boiled sterile water, so as to remove all traces of the alcohol. After use, the syringe is rinsed out with ether, and then filled with the sterilizing solution. This is then expelled and the cap placed on the syringe, which is immediately returned to the container. I use only steel needles, and they are boiled just before using.

Towels and gauze wipes are best sterilized in the auto-clave, or in some type of steam-pressure sterilizer. The wipes are made up into small packages of twelve, and wrapped in a little linen container.

After the instruments and accessories have been sterilized, and cooled (this can be done by transferring the metal instruments to a basin containing either a 2 per cent lysol, or a 1 per cent phenol solution), they are placed on the operating stand, which has previously been washed with alcohol, and covered with a sterile towel. The instruments are then also covered with another sterile towel.

CHAPTER II

EXAMINATION OF PATIENT—PRE-OPERATIVE CARE

Examination of Patient

THE examination of the patient consists of a (1) general examination, and a (2) local examination; that is, the examination of the area to be operated upon. Before any examination takes place, the name, address, age and occupation should be taken by the nurse or assistant.

General Examination.—It is not incumbent upon the dental surgeon to make a physical examination of every patient that presents for extraction. However, there are several salient points that should be observed, and will act as a guide to the operator, as to the proper handling of the case. They are the color of the skin, whether it is pale, florid, etc., pupils, demeanor, respiration, breath, pulse, and occasionally blood pressure.

Pallor of the face may indicate anemia, or weak heart action. A florid complexion may indicate high blood pressure, while whiteness or chalkiness of the skin is often seen in cases of nephritis. A golden yellow hue is frequently indicative of jaundice,

especially if the cornea are also yellow. Cyanosis and blueness of the skin is seen in cases of serious heart disease, and in pulmonary disturbances. In some cases, the blueness might be caused by overdoses of some drug, which reduces the hæmoglobin, such as acetanilid or antipyrine. Such cases are very likely to be seen in dental practice, as these drugs are often taken for the relief of pain.

A staring, unmoving pupil (Argyll-Robertson pupil), taken together with a shuffling, incoördinate gait, is often indicative of locomotor ataxia. Bulging eyes might indicate exophthalmic goitre.

The demeanor is an excellent guide as to whether or not the patient needs pre-operative care. A highly nervous patient should certainly be given some sedative. One that seems dull and lethargic, and answers questions only when asked, and then only in monosyllables, must be carefully watched. This patient may be entering upon the verge of shock due to fright, and if this is thought to be the case, the operation should be deferred, if possible, to a later date.

Noting of the respiration is often of aid. Difficulty in breathing may be due to heart failure, and lack of nutrition of the respiratory center. Heavy, wheezing, and labored breathing is often seen in the asthmatic.

The pulse is probably the most important thing to observe, and should be taken in every case. A feeble rapid pulse may indicate poor heart action, dilatation of the heart, or myocardial degeneration. A rapid full pulse may be due to the absorption of toxins and is frequently indicative of an active infection. In the latter case, it is well to take the temperature. A short, sharp pulse may indicate aortic regurgitation. The intermittent pulse, or one that occasionally drops a beat, may indicate great ventricular fatigue, seen in some cases of high blood pressure.

A radial artery that is difficult to compress, and can be rolled about under the fingers, indicates hardening of the arteries, especially if the vessels about the temples are prominent. In cases of this type, the systolic blood pressure should be taken with the sphygnomanometer.

The odor of the breath often informs us of some organic disease, that may make the extraction of teeth dangerous, unless precautionary measures are first taken. In diabetes, for instance, the breath has a peculiar sweetish odor. The smell of acetone on the breath is a dangerous indication and should preclude operating. In cases of pus and necrosis, the breath has a distinctive fetid odor.

Local Examination.—The local examination is

divided into the (1) physical, and the (2) radiographic.

Physical.—The physical examination consists of inspection of the oral cavity, tooth and surrounding tissues, including palpation for enlarged lymph nodes.

Swellings should be palpated to see whether there is any fluctuation, or whether they are solid or due to cysts. In large cysts, there is a distinctive crackling of the tissues on pressure, due to thinning of the alveolar walls.

The condition and color of the gums and oral mucous membrane must be observed. If there is pallor of the mucous membrane, we should be on the lookout for anemia or some circulatory deficiency. Turgid, congested gums, and oral mucosa, may indicate valvular disease of the heart, especially of the valves of the right side of the heart, wherein the return flow of blood is interfered with.

Suppurative periodontoclasia, Vincent's Infection, and mucous patches should be sought for. When the mouth is particularly dirty and there is much pus exuding from the necks of the teeth, unless imperative, the extraction should be deferred until the mouth has been cleaned. In Vincent's Infection, no extractions are to be entertained until the disease

is cured. If mucous patches are seen, the patient should be questioned as to syphilis, and if the extraction is not urgent, the patient should be referred for a Wasserman test. However, if the tooth must be removed immediately, the operator would be wise to protect himself by wearing rubber gloves.

The tooth is inspected as to its firmness in the jaw. The thickness of the alveolar plates should be determined also, in order to judge where the force of extraction is to be applied. A loose tooth does not always mean a tooth affected with alveolar absorption. The crown alone may be loose, due to a fracture, and the operator will be baffled into believing that the tooth is simple to remove. Very often, the tooth is in the seat of some diseased condition, such as carcinoma, necrosis, or cyst, and is loose because of the loss of its bony support. Enlarged lymph nodes are indicative of some active infection. Where there is a solid tumor mass in the mouth and the lymph nodes, in anatomic relationship, are enlarged, malignancy is to be suspected.

Radiographic Examination.—No tooth should be extracted unless it has been previously radiographed. The radiogram will disclose the shape, number, and position of the roots. It will also enlighten the

operator as to whether any exostosis exists, or whether there is any pathological condition at the apex.

The radiogram requires but a few moments to take, and develop, and is the most helpful adjunct we have to guide us as to the proper operative procedure.

Pre-Operative Care

The pre-operative care is determined by the examination of the patient. If the patient appears normal and not unduly excited, no pre-operative medication is necessary. It might be said in passing that in the vast majority of cases we do not have to resort to pre-operative medication, but we must always be on the watch for those cases, where it is indicated. The patient should at all times be assured that the operation will be painlessly performed, and that he or she should have no fear. If the tooth appears to be a difficult one to remove, the patient is acquainted with this fact beforehand. Also that the operation will require some little time, but that all measures will be taken to have it done as quickly and painlessly as possible.

If the patient is highly nervous, the triple bromides of Burroughs, Welcome & Co. (one tablet dissolved in a half a glass of water), given fifteen

minutes before operating, will act as a most satisfactory sedative.

When upon examination, the blood-pressure is found to be high, the amount of adrenalin in the anæsthetic solution is lowered. If the blood pressure is unduly high, the operation should be deferred until it has been reduced. If, however, the extraction is urgent, it is wise to demand the presence of the family physician.

Diabetics should be sugar-free before being operated upon. In known cases of severe heart disease, compensation of the heart muscle should be attempted to be established. If the extraction is imperative, the family physician is again demanded in attendance.

We will occasionally meet with cases of severe heart trouble, or excessively high blood pressure that demand immediate attention, and we are unable to get a physician to be present. In these cases, pre-operative medication is indicated. In the case of the high blood pressure, if the adrenalin content of the anæsthesia is lowered to a minimum, if not entirely left out, and if the patient is given a tablet of nitro-glycerine, 1-100 gr., to be dissolved on the tongue, we can usually tide this patient over the operation very nicely. In cardiac disease, the heart can usually be stimulated enough to proceed

with the extraction, by the administration of the tincture of digitalis, 10 drops in a little water, or strychnine sulphate 1-60 gr. given hypodermically, or a tablet dissolved on the tongue.

In all events, the operator should be calm and self-reliant, and the patient treated with the utmost kindness and assurance. The psychic effect upon the patient of gentleness and tranquillity goes a long way toward inspiring confidence, and often accomplishes a great deal more than medication. "Calamity howling" is to be deprecated. While a severe case is not to be treated lightly, nevertheless the patient should not be frightened unduly.

CHAPTER III

INDICATIONS AND CONTRA-INDICATIONS FOR EXTRACTION—POSITION OF THE OPERATOR AND PATIENT —OPERATION OF EXTRACTION

Indications and Contra-Indications for Extraction

Indications.—With the advent of modern root-canal therapy, and the advances made in orthodontia, there seems to be less indication for the removal of teeth than formerly. The following are the prime indications for the extraction of teeth:

1. All teeth that will not yield to correct root-canal therapy and surgery. There are very many teeth that can be safely retained in the mouth by the correct treatment with one of the modern methods of root-canal therapy. In single-rooted teeth, apicoectomy may be resorted to. Where these methods fail, the tooth must be removed.
2. Teeth affected with periodontoclasia. Where more than two-thirds of the bony support is lost, the tooth should be extracted.
3. Teeth that are the cause of cysts and necrosis.
4. Teeth whose pulps must be removed, but where the canals cannot be filled properly.

Fig. 3.—Position of operator in extracting upper left bicuspids and molars.

Fig. 4.—Position of operator in extracting upper anterior teeth.

Fig. 5.—Position of operator in extracting upper right bicuspids and molars.

Fig. 6.—Position of operator in extracting lower bicuspids and molars.

5. Teeth that hinder the proper construction of a bridge or denture.
6. Teeth that are acting as a focus of infection.

Contra-Indications.—There are really no contra-indications in the tooth *per se*, except that no tooth should be extracted that can be brought back to a state of health by proper treatment. The contra-indications lie in the patient's condition. The following diseases forbid the extraction of teeth, unless they are controlled beforehand:

1. Severe anæmia of any type, especially pernicious anæmia.
2. Jaundice.
3. Hæmophilia.
4. Severe heart trouble.
5. Excessively high blood pressure.
6. Diabetes.

However, where pain makes the extraction imperative, chances must be taken, and any untoward sequelæ will have to be combated as they arise.

Position of Operator and Patient

In extracting all upper left molars, bicuspids and all upper anterior teeth, the operator stands to the right and slightly in back of the patient. (Figs. 3 and 4.) The chair is lowered until the head of

the patient is on about a level with the cnest of the operator. The patient sits fairly bolt upright. The left arm of the operator is crooked about the head of the patient, and the head is pressed against the lower part of the operator's chest. In the case of the molars and bicuspids, the cheek is held away

Fig. 7.—Position of forceps in extracting lower molars and bicuspids, while standing in front of the patient. Note position of the left hand in protecting the jaw from any possibility of fracture.

with the index and third fingers, while with the anterior teeth the lip is held away with the index finger, and the third finger is placed on the palate opposite the tooth to be extracted.

Fig. 8.—Position of operator in extracting the lower anterior teeth.

In extracting the upper right molars and bicuspids, the operator stands in front and to the right of the patient. (Fig. 5.) The patient assumes the same position in the chair as above, but the chair is raised until the face of the patient is on a level with that of the operator's. The cheek is held away with the thumb or index finger of the left hand.

In extracting the lower molars and bicuspids, the operator stands in front and to the right of the patient. (Fig. 6.) The patient still maintains the same position in the chair, but the chair is again lowered until the head of the patient is once more on the same level with the operator's chest. The index and middle fingers are placed on either side of the tooth and the thumb is placed on the under surface of the body of the mandible.

In removing the lower anterior teeth, the operator stands more directly in back and only slightly to the right of the patient. (Fig. 8.) The chair and patient are kept in the same position as for the extraction of the molars. The lower lip is held away with the index finger and the thumb is placed on the lingual surface of the jaw, while the rest of the hand is under the chin as a brace.

Where it is decided to remove teeth in both jaws at the same sitting, those in the lower jaw should

be extracted first. If the upper teeth are removed first, the blood from the wound is liable to obscure the operator's vision.

Operation of Extraction

Stellwagon, in an article on the extraction of teeth, in "The American System of Dentistry", divides the steps of extraction into three:

1. Grasping of the tooth.
2. Loosening of the tooth.
3. Removal of the tooth.

This is a most satisfactory division and aids the description of the operation greatly.

Fig. 9.—Dissection of skull showing the position of the upper teeth in their alveoli. Note thickness of the palatal alveolar plate in comparison with the buccal and labial plates. (For permission to use this picture I am indebted to Dr. Dunham, of the *Dental Digest*.)

Grasping of the Tooth.—The forceps beaks should be placed under the free margin of the gums and pushed up or down, as the case may be, as far as

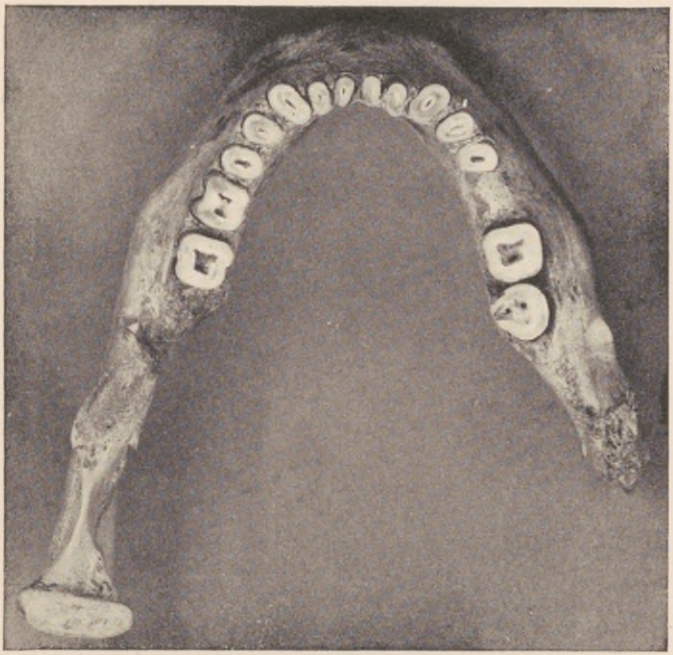

Fig. 10.—Mandible with the teeth ground down showing their positions in the alveolar process.

possible. The forceps are then closed tightly on the tooth.

Loosening of the Tooth.—The attachments of the tooth to the socket are broken by the proper

movement of the tooth. A knowledge of the anatomy of the teeth, their position in the alveoli, as well as the alveolar process and the jaws, is essential. (Figs. 9 and 10.)

The upper central incisors are loosened with a slight rotating movement, and then by moving the tooth labially and palataly, with the strongest force toward the labial.

The upper laterals cannot as a rule be rotated, because of the shape of their roots and also because they generally have small, fine apices, with a slight distal curve. Rotating these teeth would in many cases break off the apex and complicate the extraction. They are loosened with a labial-palatal movement.

The upper canines are loosened in much the same manner as the centrals. A great deal of force is sometimes needed to break the attachments of this tooth, and care must be exerted not to fracture too much of the alveolus.

The upper bicuspids are loosened with a buccal-palatal movement, the stronger force being applied buccally. The upper first bicuspid has two roots and very often fractures at the palatal root. Care must be exercised to prevent this accident from happening.

The upper first and second molars are loosened

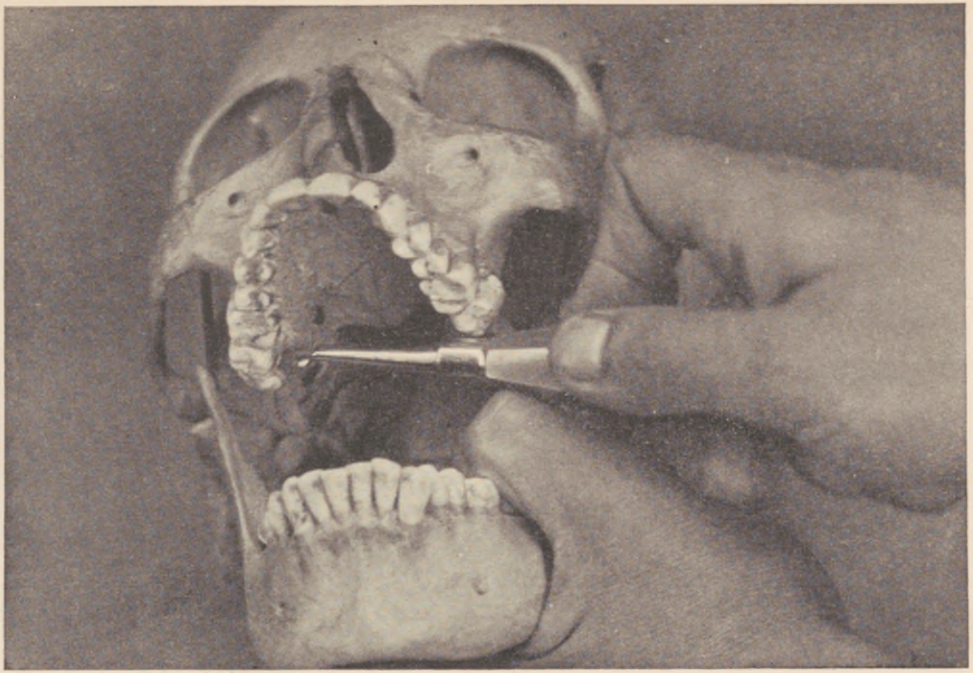

Fig. 11.—Showing method of elevating and loosening upper third molars.

with the buccal-palatal movement, again exerting the greater force buccally.

Upper third molars have the same force applied to them as in the case of the first and second molars, except when they assume a buccal position. In this case, an elevator (No. 12C, S.S.W.) can be inserted between the third and second molars and the third molar elevated downward and distally. (Fig. 11.) This will sufficiently loosen the tooth, so that it can be easily grasped, and removed with the forceps.

The lower incisors and laterals cannot well be rotated because of the narrowness of their roots, and also because they are often so close together, that rotation would loosen the adjoining tooth. A labial-lingual movement, with the stronger force labially, will dislodge them.

The lower canines are loosened in the same manner as the incisors and laterals, although in some cases rotation toward the distal will aid in breaking the attachments.

The lower bicuspids frequently present difficulties in loosening, since they are often affected with excementosis. In the normal tooth, rotation, with a strong buccal movement, will loosen them.

The lower first and second molars have their attachments broken by a bucco-lingual movement.

Very often the buccal plate is thicker than the lingual one, and stronger pressure can be applied toward the lingual plate. However, it must be borne in mind not to injure the lingual nerve, which runs along the lingual surface of the body of the mandible, in the region of the lower molar teeth.

The lower wisdom teeth are usually situated more buccally than lingually, so that the thickest portion of the bone is lingually; hence, pressure must be used in a buccal direction.

The Removal of the Teeth.—After the attachments of the tooth have been broken, its delivery is quite simple, by using gradual traction downward and outward. Occasionally, the upper molars will have to be drawn downward and palataly. The tooth must be removed slowly and gradually, so that as little process as possible, preferably none at all, is taken with the tooth. If any gum adheres to the tooth, the withdrawal should be stopped, and the gum freed from the tooth with a sharp lance or scissors. If this precaution is not heeded, a very ugly tear may result, which will necessitate suturing.

The Use of the Elevator.—The principle of the elevator is based upon that of the lever. We have embodied the power, fulcrum and resistance in this operation. The power is the strength exerted by the operator. The fulcrum is usually the adjoining

tooth, and the resistance is the root. By a lifting movement the root can be raised out of the socket. Sometimes we can protect the fulcrum tooth by placing our finger over it and elevating against the finger. (Fig. 12.) The flat side of this instrument is placed against the root and the convex side against the fulcrum. The blade portion should be

Fig. 12.—Showing method of elevating roots. Note the position of the elevator and finger of the left hand acting as the fulcrum.

forced between the root and wall of the socket, if possible.

Great care must be exerted in elevating roots, not to loosen the fulcrum tooth. If the root does not come out easily, it is better practice to remove it by one of the surgical methods.

CHAPTER IV

REMOVAL OF ROOTS AND APICES—THE CARE OF THE GUMS AND PROCESS IN THE MULTIPLE EXTRACTION OF TEETH

The Removal of Roots and Apices

No operator is so infallible as to never break a tooth during extraction. This in no way detracts from his ability. It is impossible to remove some teeth *in toto*, due to malformations of their roots. If, however, this accident should occur, the broken portion must not be left in the jaws. It has been the custom of some men to leave these fragments behind, telling the patient that nature would exfoliate them. This is bad practice, because it has been found that these root-ends are not always expelled, and often became serious foci of infection. Properly administered local anæsthesia gives us ample time to immediately remove, both carefully and painlessly, these fractured roots and apices.

If a crown should be broken off during extraction, an elevator can be inserted between the root and the socket, and by using the adjoining tooth as a

fulcrum, the root can be raised with a lifting movement. Care must be taken not to loosen the adjoining tooth. Very often, by insinuating the narrow beaks of the root forceps underneath the gum, the root can be extracted. We must, however, be careful not to mutilate the tissues.

There are those cases, where an apex is fractured, or a root is broken too deeply in the jaw to be removed by either the elevator or root forceps. For example, this may happen during the extraction of an upper lateral, which has a fine apex curved distally, and is prone to break at this point. In these types of cases, some operators lay back a muco-periosteal flap, remove the outer plate of the alveolus, extirpate the root, and then suture the flap back in position. This operation leaves a deformity in the alveolar process and makes prosthetic replacement difficult. The following technique is much more satisfactory and is applicable to the removal of apices and roots of all anterior teeth, upper second bicuspids, lower bicuspids, buccal roots of upper first bicuspids, and occasionally the buccal roots of the upper first and second molars.

A semi-lunar incision about three-quarters of an inch in length is made in the region of the fractured apex. (Fig. 13.) The concavity of the incision is oward the apex, and the convexity toward the crown

of the tooth. It is identically the same as the incision made for the operation of apicoectomy. A muco-periosteal flap is raised, and a window cut either with a bur, or chisel in the outer plate of the alveolus, in the vicinity of the apex. (Fig. 14.) The apex is exposed, pried loose with an elevator, or small

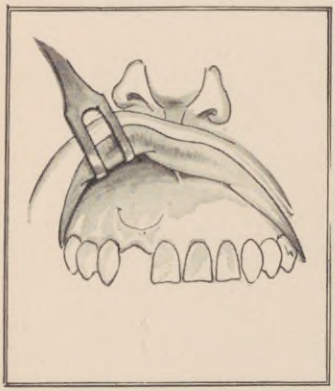

FIG. 13.

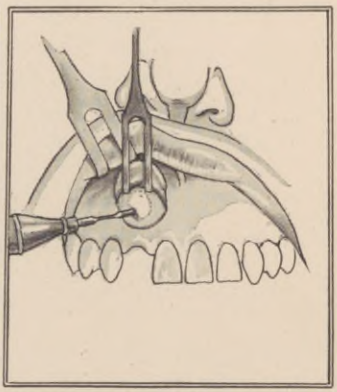

FIG. 14.

Fig. 13.—Primary incision. Fig. 14.—Flap raised and window being cut in the outer plate with a bur.

chisel, and removed through the alveolar opening. (Fig. 15.) If any pathological tissue is present, it can be conveniently curetted away through this same opening. The edges of the bone are then rounded and the wound irrigated. The flap is returned to its former position and held there with

sutures. (Fig. 16.) The gum about the incision is carefully dried, and the area painted with a solution of iodoform, oz. 1 and collodion, oz. 7. This solution dries quickly and protects the wound from the possibility of infection from the mouth. It will remain in place from twenty-four to forty-eight hours.

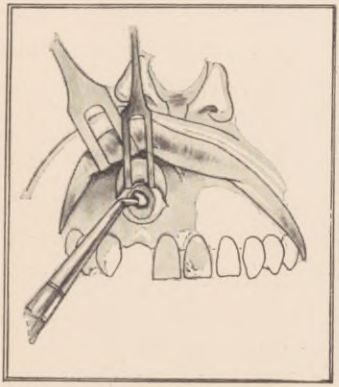

FIG. 15.

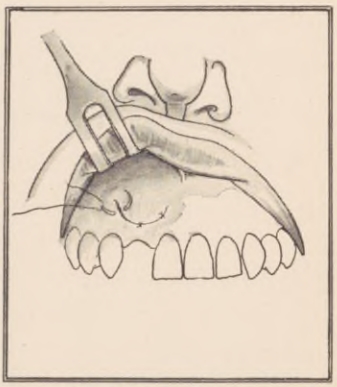

FIG. 16.

Fig. 15.—Apex exposed, and being extirpated with an elevator.
Fig. 16.—Flap returned to its original position and held in place with sutures.

Healing of the incision takes place by first intention, and in four or five days the sutures can be removed. Care must be taken in performing this operation on lower bicuspids, not to injure the mental nerve.

When a larger fragment of the root is broken, than an apex, the alveolar opening is made of

sufficient size to admit of the free delivery of the fractured piece.

This operation retains the continuity of the alveolar ridge, and makes the future prosthesis simpler and better looking.

If the palatal root of the upper molars or first bicuspid is broken off, the septum between the roots is removed with the bur or a fine beak rongeur forceps. The root can then be very easily elevated. In the case of a lower molar root being fractured, the same procedure is followed out.

The Removal of Molars Where the Crown Is Badly Decayed, or Has Been Broken Off During the Extraction.—Very often, an upper or lower molar will present itself for extraction where the crown is so badly decayed that it will immediately snap off at the neck. In these cases, it is best to remove the broken-down crown at once. The patient should be told that this is intended, otherwise he will think that the tooth was accidentally fractured and will lose confidence. The remaining roots are removed according to the following technique. Let us take, for example, the upper first molar, although the lower molars can be removed in the same way.

Two parallel vertical incisions are made, one, slightly mesially, and the other distally, to the tooth to be operated upon. (Fig. 17.) The incisions need

FIG. 17.

FIG. 18.

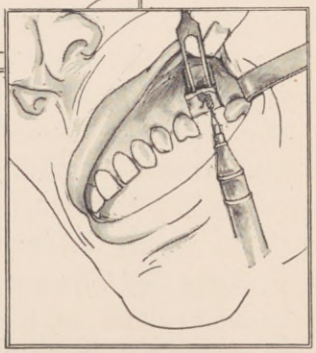

FIG. 19.

Fig. 17.—Position of incisions. Fig. 18.—Flap raised and the outer plate being removed by means of a short, sharp chisel. Fig. 19.—Bifurcation of roots exposed and the roots being severed with a bur.

not extend to the apex, but merely half way up the root. A muco-periosteal flap is then made and retracted. With a small sharp chisel, enough of the buccal alveolar plate is removed to extend barely above the bifurcation of the buccal roots. (Fig. 18.) With a fine cross-cut fissure bur, placed against the bifurcation (Fig. 19), the buccal roots are divided, running the bur toward the palatal root. The cutting is then continued mesially and distally so as to sever the palatal root from the buccal roots. We have thus divided these roots one from the other. The area is now irrigated to wash away the grindings, and dried with sterile gauze. The roots can now be easily removed with the elevator and root forceps. All rough edges of alveolus are straightened and smoothed, and the flap restored to its original position. It is rarely necessary to use sutures to hold it in place.

The advantages of this operation are that: (1) it leaves a clean wound; (2) there is no traumatism to the tissues; (3) it is quickly performed; (4) there is scarcely any after-pain.

Occasionally, the roots may be exostosed or curved to such an extent that they cannot be removed unless the greater portion of the buccal alveolar plate is taken away. In cases of this type, the incision is extended to the apices of the tooth, and a larger

flap retracted. The roots are divided in the same manner described above and the buccal plate slowly chiseled away. Care must be taken not to chisel too quickly or with too much force, because a large strip of alveolus may become dislodged. From time to time, the roots can be attempted to be pried loose, and very often one or two of the roots will be elevated out, or grasped and removed with the root forceps. Sufficient outer plate is taken away until the remaining root or roots, as the case may be, can be delivered through the opening. The alveolus is then straightened, all thin and rough edges are removed, including a goodly portion of the septum, and the area irrigated. The method of closing the wound, that is, the return of the flap, is determined by the amount of alveolus removed. Where not much of the outer plate has been taken away, the flap can be returned to its original position, sutures not being necessary. But where a large amount of alveolar plate is taken away, the following technique for the closure of the wound has been found most gratifying.

The outer plate is removed with rongeur forceps until we have a freely pendulous flap. The mesial and distal sides of the socket are well rounded, leaving no sharp edges. The gum covering the palatal plate now is loosened with a periosteal

elevator, and enough of the palatal plate removed to leave this portion of the gum also free. (Fig. 20.) The removal of this plate is determined by the length of the buccal flap. All we need is enough free gum on this side, so that we can get approximation with the buccal flap. The latter is now brought

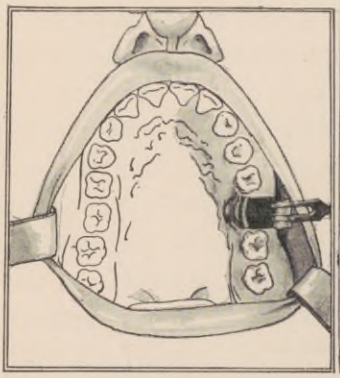

FIG. 20.

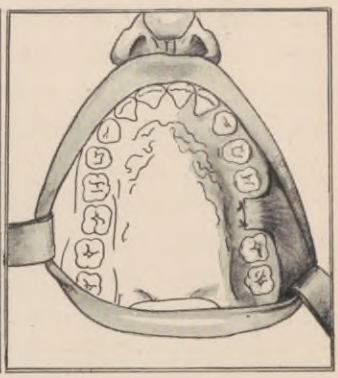

FIG. 21.

Fig. 20.—Outer plate removed, leaving the buccal flap hanging pendulous. Palatal mucosa raised.

Fig. 21.—Buccal flap sutured across socket to palatal mucosa.

across the socket toward the palatal flap and the parts approximated and held with sutures. (Fig. 21.) The edges of the flap need not necessarily touch. Of course, this is preferable, but may entail too much bone removal. The flaps should be brought in as close apposition as possible. The same

procedure works equally as well in the lower jaw.

This method of closing the wound is preferable to the ordinary returning of the flap to its original position, as it does away with the packing of the socket, and leaves the wound closed, without fear

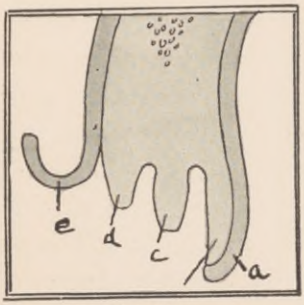

FIG. 22.

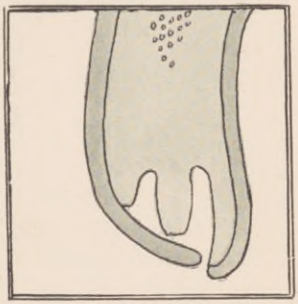

FIG. 23.

Fig. 22.—Part of outer plate and septum removed. Buccal flap freed from bone. (*a*) Palatal mucosa, (*b*) palatal plate, (*c*) septum, (*d*) outer plate, (*e*) buccal flap.

Fig. 23.—Buccal flap laid in socket in much the same manner as one does in certain types of cyst operations.

of the ingress of food. It is especially useful where the antrum has been opened, either purposely or accidentally.

In those cases where too much plate has not been removed, and the socket is not too deep, we will very often find that instead of suturing the flap across, we can lay it in the socket, forming a sort

of lining, as is done in large cyst operations. This protects the socket and facilitates healing. (Figs. 22, 23 and 24.)

The Care of the Process Where a Number of Adjoining Teeth Are Removed.—Very often, we are called upon to remove two or more adjacent teeth. This leaves a jagged wound and healing takes considerable time. Also, when the tissues do finally heal, the alveolar ridge is left in an irregular or "bumpy" condition, and it is sometimes extremely difficult to fit dentures or bridges in these mouths. Frequently, the periosteum contracting over little sharp edges of alveolar process is the cause of a severe and insidious neuralgia. We can therefore avoid much future discomfort to the patient by

Fig. 24.—Model made two weeks after this method had been performed. Note the splendid healing and extremely slight deformity.

proper attention to the process directly after the extractions.

Small vertical incisions are made on either side of the operative field, and the labial gum and periosteum raised and retracted. Any interdental connections are severed with a fine curved scissors. The rough and protruding edges of the alveolus are removed with the rongeur forceps and smoothed with large mastoid curettes. The area is now irrigated and the flap returned to its place. By running a finger over the gum, we can discover any sharp points that may be present. If any are found, the flap is again raised and the sharp edge removed. When we are certain that the alveolus is smooth, the uneven edges of the gum are trimmed and the flap laid back in place. It is not necessary to suture or pack the wound. The gum is carefully dried and the iodoform-collodion solution applied. Healing takes place promptly and usually without any pain.

CHAPTER V

ACCIDENTS

THE following are the accidents that may complicate tooth extraction:

1. Fracture of the tooth.
2. Loosening of the adjacent tooth.
3. Fracture of the alveolus.
   (a) Fracture of the tuberosity.
4. Opening of the antrum.
   (a) Forcing tooth into the antrum.
5. Dislocation of the jaw.
6. Fracture of the jaw.

Fracture of the Tooth.—This is the commonest accident that may happen during the extraction of a tooth. The fractured portion must be removed and this can be done by any of the methods described in the preceding chapter.

Loosening of the Adjacent Tooth.—As a rule, this accident is due to carelessness on the part of the operator. It is most liable to happen in removing the lower incisor teeth or in attempting to elevate a root. There are those cases, though, where one tooth is fused to another. This is a compara-

tively rare occurrence and can be determined beforehand by a radiogram. If a tooth should become loosened, it can be ligated to its neighbors with orthodontic wire, or Chinese grass line. The tooth will, as a general rule, become tight again. However, this accident is avoidable, and every operator should take care to see that it does not occur.

Fracture of the Alveolus.—The alveolar process is fractured in a more or less degree in the vast majority of extractions. If the piece broken off is a small one, it should be immediately removed and the edges of the alveolus rounded with the rongeur forceps and curettes. Even fairly large pieces of process should be removed, as there is little likelihood of their becoming re-attached, and, if left, necrosis of the process may follow.

In extracting upper wisdom teeth, the tuberosity is liable to fracture. There is not much to do in these cases, but to remove the broken piece, trim the rough edges of bone, and cut away the redundant gum. Sometimes the edges of the gum can be approximated and sutured together over the gap created.

Opening Into the Antrum; Forcing a Root Into the Antrum.—Very often the palatal roots of the upper first and second molars, and sometimes the roots of the bicuspids, penetrate the maxillary sinus,

and, consequently, in removing these teeth, the antrum is opened. This calls for no treatment, unless the patient is suffering from a mixillary sinusitis. If the case is uncomplicated, the socket can be lightly packed with iodoform gauze to prevent food from entering and changed daily for a few days.

Occasionally, a root may slip into the antrum. This is liable to happen while trying to elevate these roots. When it does occur, the root must by all means be removed, as its presence may cause a severe infection of the antrum. There are several methods for its recovery. We should try the simplest one first. After the root has entered the antrum, a radiograph is taken, to try to locate its exact position. The opening into the antrum is then enlarged with fine-beak rongeur forceps, and a surgical bur. A large enough opening should be made that would admit the tip of the little finger. Of course, it must be understood that we do not actually put our finger into the wound. In doing any operation involving the maxillary sinus, absolute asepsis is imperative. After the opening has been made of sufficient size, we can try irrigating the sinus through the socket, with a mild boric acid solution. Frequently the root can in this way be washed out. If this is not successful, we can introduce a silver probe, bent at an angle and slightly hooked at the

end. By groping along the floor of the antrum with this instrument, we may be able to "fish" out the root. If both of these methods do not succeed, the antrum must be enlarged sufficiently so that we can see into it. A muco-periosteal flap is raised, and the outer alveolar plate removed, until we have a clear view into the antrum. An antrum lamp is introduced and the sinus thoroughly inspected. The root now will be seen and can easily be grasped with a mouse-tooth forceps or "teased" out with a curette. The method of closing the antrum presents a problem and is governed by the condition found within the antrum itself. Where we have been successful in removing the root without taking the outer alveolar plate away, we can irrigate the sinus and pack the socket with iodoform gauze. This treatment will usually suffice. The gauze is changed daily until granulation takes place and the antrum is entirely closed. The majority of these cases make an uneventful recovery. We must, however, be watchful, for we might have unwittingly introduced some infection into the antrum, no matter how scrupulous our asepsis might have been.

If the outer plate has been removed, and the antrum is clean, we can then close the wound by suturing the flap across the socket in the same manner described for the closing of the socket where

a root has been removed surgically. In this case, however, a piece of iodoform gauze is inserted between the sutures to insure drainage in case any untoward event should happen.

If the antrum should be found diseased, the routine treatment for maxillary sinusitis is carried out. For a description of this treatment, the reader is referred to works on oral surgery.

Dislocation of the Jaw.—In the removal of lower teeth, the mandible is liable to become dislocated. Occasionally, this may also happen, if the patient attempts to open the mouth too far. It is an awkward accident, but can easily be remedied. The chair is lowered as far as possible, and the back adjusted so that the patient sits bolt upright. The operator stands over the patient in a straddled position. After wrapping the thumbs well in cotton, they are placed on the occlusal surfaces of the lower molar teeth, and the under surface of the body of the mandible grasped firmly with the rest of the hand. By pressing the mandible downward and backward, and tilting the chin upward, the condyle is slipped back over the emenentia articularis into the glenoid fossa. (Fig. 25.) The jaws are then held together with a Barton bandage for twenty-four hours.

Fracture of the Jaw.—The mandible is liable to

Fig. 25.—Position of the operator and patient in reducing a dislocation of the mandible. Note how the thumbs of the operator are protected by wrapping them in cotton.

fracture, due to some diseased condition of the bone, such as necrosis, large cysts, fragitalis ossium. It also may be fractured by undue force applied in extraction, especially in the region of the mental foramen. This accident, while it rarely occurs, is most distressing, both to the patient and to the operator.

The treatment of these cases is the setting of the jaw, being guided by the occlusion of the teeth, and then wiring the mandible to the maxilla according to one of the approved techniques. If there is any diseased condition of the jaws present, it must be treated accordingly.

CHAPTER VI

AFTER-PAIN

Pain after the extraction of a tooth is a fairly common occurrence. It is usually due to: (1) a faulty anæsthetic solution; (2) probing for landmarks with the hypodermic needle; (3) trauma to the tissues; (4) infection of the socket; or the so-called "dry socket."

The Anæsthetic Solution.—Great care must be exerted in using fresh isotonic solutions. The injection of hypo- or hypertonic saline vehicles often causes great distress. All anæsthetic solutions should be freshly prepared immediately before use. I have seen dentists keep an uncorked stock bottle of some local anæsthetic on their cabinets, and when a patient presented for the extraction of a tooth, dip their syringe into the bottle, and inject this solution. No good can come from such practice, and it cannot be too strongly condemned. I use the procain-suprarenin tablets and dissolve them in sterile normal saline solution immediately before injecting. Where a man does not wish to go to this trouble,

several reliable manufacturers are now putting out ampoules of procain solution, ready for immediate use. Unless an operation is sure that he can prepare a sterile isotonic local anæsthetic, he is better off to use these ampoules.

Probing for Landmarks With the Hypodermic Needle.—Frequently, in probing for a foramen the periosteum is scraped. This especially occurs in the mandibular injection. A proper knowledge of the anatomy of the jaws and the various exits of the branches of the trigeminus nerve will obviate a great deal of groping and probing for these foramina.

Treatment.—Pain due to these causes can easily be differentiated from that caused by an infected socket, because it is usually confined to the point of injection. In the mandible the patient will often complain of discomfort in opening the mouth. Little can be done. The pain will wear off as the tissues heal. Sedatives are prescribed, as well as warm mouth washes. Very often, dry heat applied to the face will afford some relief. However, this should not be advised if we suspect the presence of any infection.

Traumatic Injuries to the Tissues.—Lacerating extractions are the cause of a great deal of after-pain. They are most liable to occur under general anæsthesia. If the tooth is removed gently with

the minimum amount of disturbance to the tissues, much will have been done to avoid after-pain. If a root is broken off during extraction, it should be removed surgically, according to the methods described in the previous chapters.

Treatment.—Under local anæsthesia, all lacerated soft tissue is trimmed with a fine curved scissors. Loose pieces of alveolus are removed, and rough edges of bone smoothed with rongeur forceps and spoon curettes. The wound is then irrigated with a warm antiseptic solution, and packed lightly with iodoform gauze. Warm mouth washes and some sedative is prescribed.

The So-Called "Dry Socket."—Painful sockets after extraction occur quite frequently. The pain arising from this condition is sometimes excruciating, preventing sleep and making the patient miserable. Some men have attributed this condition to a lack of bleeding in the socket, but this is only a description of one of the symptoms. It is an alveolitis, or osteitis of the socket, due to a low-grade infection.

Symptoms.—The chief subjective symptom is great pain of a neuralgic character. The patient is harassed and unable to sleep. I have seen patients lose five pounds in a week during an attack of this kind. Objectively, the socket is devoid of healthy

granulations. There is no healing clot, and if a swab is introduced into the socket it will be found to have an offensive odor.

Treatment.—Many remedies have been suggested for the relief of this condition. There is little need of placing anodynic or anæsthetic dressings in the socket, or prescribing sedatives, unless the cause is removed, and that is, combating the infection present.

Under complete local anæsthesia, the socket is irrigated, in order to wash out all particles of food. The necrotic walls and the floor of the socket are next thoroughly curetted, until healthy bone is reached; this is indicated by bleeding from the walls of the socket. The wound is again irrigated, dried, and swabbed out with Churchill's Iodine. The socket is now packed with iodoform gauze into which has been incorporated procain powder, rubbed up in white vaseline, or better in mentholated vaseline. This paste is easily made by placing procain powder and mentholated vaseline in a mortar, and rubbing them up together with the pestle. The gauze is then dipped in the paste and carried into the socket. Mentholated vaseline is preferable to the plain, because the menthol is both anæsthetic and antiseptic.

A most useful adjunct to the treatment of "dry

socket" is the injection of a mixed vaccine, as an aid to overcome any deep infection in the tissues. The most useful of these vaccines is the one of Dr. Goldenberg of Paris. It can be injected intra-orally, and is a mixed stock vaccine, made from bacteria taken from the oral cavity. It is so concentrated and treated that small doses, which are necessarily needed to be injected in the mouth, contain the desired amount of bacteria to be effective. There is little or no local reaction. The use of vaccines has such an important place in combating post-operative infections, that I have devoted a chapter to their special use in dental surgery.

The packing in the socket is changed daily until all pain has subsided, which is a good indication that the infection is controlled. Warm mouth washes and sedatives are also prescribed. If the patient has lost much sleep, some hypnotic, such as allonal, can be given. Sleep to these patients is a great boon, and all efforts should be made to induce it.

Prophylaxis of After-Pain.—Post-operative pain is sometimes more easily prevented than controlled. It behooves us, therefore, to take precautionary methods to prevent it. Careful preparation of the anæsthetic solution, together with its proper introduction, will go a long way to accomplish this.

Gentle handling of the tissues during the operation will also aid in preventing after-pain. In cases where the socket is suspected of being infected, it is well to curette the walls and, after irrigating, insert a light dressing of iodoform gauze.

Before closing this chapter, I should like to cite the following case, as it is illustrative of a most important point, and also emphasizes the need of close examination and correct diagnosis, as to the source of pain.

"Mrs. B. Removed the upper right first molar. The extraction was accomplished without any difficulty. Three days later the patient returned with the most excruciating pain in the region where the tooth had been removed. On examination, the socket appeared to be healing nicely and there was no inflammation about it. I looked at the adjoining teeth and found a deep cavity beneath the free margin of the gum on the distal surface of the second bicuspid. There was a severe pulpitis present with exposure of the pulp. As much decay was removed as possible, the cavity irrigated with a warm bicarbonate of soda solution and oil of cloves sealed in. The pain disappeared immediately."

Cases of this kind have been frequently brought to my attention. It is fairly common to find cavities in the teeth adjoining those that are removed, espe-

cially if the extracted tooth happened to be crowned, or had a large filling in its approximal surface. The patient may not experience any discomfort until the adjacent tooth is removed. The cavity is then exposed to thermal change and the fluids of the mouth, and a pulpitis results.

In all cases of extraction, it is wise to examine the teeth on either side of the socket, and if a cavity is present, to seal some antiseptic sedative in it.

CHAPTER VII

HÆMORRHAGE—SYNCOPE—SHOCK

Hæmorrhage following tooth extraction is not very common. Unless the patient is a true hæmophiliac, or is suffering from some condition that has altered the character of the blood, such as anemia, jaundice or diabetes, the hæmorrhage is not dangerous. Before removing a tooth, it is wise to question the patient as to whether they bleed freely or are true "bleeders." As a rule, a hæmophiliac will convey this information to the operator without being asked. If there is excessive bleeding from our needle puncture, it is often indicative of the fact that the patient bleeds freely.

Prevention of Hæmorrhage.—In cases where it is known that we are dealing with patients that are predisposed to hæmorrhage, precautionary measures must be taken to increase the coagulation time of the blood. Any disease responsible for this condition should be corrected, if possible, by the family physician. Some people bleed freely without having any organic reason for it. To them, calcium lactate

can be administered, 20 grains three times a day, for several days before the operation.

Causes of Hæmorrhage Following Tooth Extraction.—The causes of post-extraction hæmorrhage are either local, that is, some condition within the wound itself that prevents the blood from clotting, or general, in which the blood itself lacks some element that delays its coagulation.

Local Causes.—Very often, a piece of loose alveolus is present in the socket that interferes with the clotting of the blood, or there may remain some granulomatous tissue which is very vascular, and keeps continually oozing. Occasionally, in the lower jaw, necrosis of the socket may penetrate to the inferior dental canal, and cause a sloughing of the inferior dental artery.

Treatment of Local Causes.—The first thing to do in all cases of hæmorrhage is to make a careful examination of the socket. It is best to re-anæsthetize the area, so as to do this more thoroughly. All blood clot is picked out and the socket irrigated with a warm saline solution. The wound is then dried with sterile gauze, and inspection made as to whether the bleeding is coming from the gum, or the socket proper. If the bleeding is coming from the gums, simple pressure on the tissues, with gauze saturated with a solution of adrenalin-

chloride, 1-1000, will, as a rule, be sufficient to stop it. The pressure can be continued by placing a piece of modeling compound over the gauze, chilling the compound, and having the patient close on it.

When the bleeding comes from the socket, the cause must be ascertained. If any loose pieces of alveolus are present, they should be removed. A fine curette can be passed to the bottom of the socket and granulomatous tissue felt for. We can readily tell if there is any of this tissue present by the soft, velvety "feel" conveyed to us by the curette's contact with it. If granulations are present, they must be thoroughly scraped away, even if it necessitates surgical exposure of the socket. If we find that the inferior dental canal has been opened, pressure on the bleeding parts will usually cause a cessation of the hæmorrhage. It is almost impossible to ligate the inferior dental artery, and I have never seen any bleeding from it that could not be stopped by pressure.

After the socket has been thoroughly cleaned, it is then irrigated and dried. Iodoform gauze saturated with adrenalin-chloride is packed tightly in the socket, and over this modeling compound is placed and the patient told to close the teeth.

A most useful adjunct to the treatment of local

hæmorrhage is the sub-mucous injection around the socket of a weak adrenalin solution. Five drops of adrenalin-chloride, 1-1000, to 10 c.c. of normal saline are the proportions used. Seven or eight minums of this solution are injected buccally and the same amount palataly or lingually, about the bleeding socket. This procedure works excellently, and it is my practice to use it in every case of local hæmorrhage.

The patient is kept in the office until all bleeding has ceased. The modeling compound is then removed and the patient instructed to stay quietly at home, and to keep cold applications on the outside of the face for the remainder of the day. The packing is kept in the socket for three days, and is then gently removed. It is rarely necessary to repack the wound.

Hæmorrhage Due to General Causes.—There are several diseases that alter the condition of the blood to such an extent that its coagulation time is greatly decreased. These are hæmophilia, probably the most important of all; pernicious anemia, scurvy, diabetes, jaundice, and purpura. Hæmorrhage associated with these conditions often assumes fatal proportions and taxes the skill of the operator to stop.

Hæmophilia.—This disease is probably the com-

monest cause for fatal hæmorrhage following the extraction of a tooth. It is now believed that it is due to a deficiency in the quality or quantity of the prothrombin. Probably the deficiency is more in the quality than in the quantity. It is thought to be a congenital defect in the prothrombin whereby it takes much longer to form thrombin. Hæmophilia bears certain oddities, in that bleeding in some parts of the body may prove more fatal than in others. Wounds below the neck may not bleed excessively, while cuts, bruises, or operative wounds of the cheeks, gums, or lips may result in death. In hæmophilia it is the capillaries rather than the arteries that ooze. There is no evidence on hand to show whether hæmorrhage of purpura, scurvy, pernicious anemia, or jaundice have the same pathology, although they act in the same way.

Treatment.—Hæmophiliacs are best placed in the hospital for treatment. The clotting of the blood may be hastened by the injection of horse serum, or, if this is not available, diphtheria antitoxin will answer the same purpose. Very often, whole blood taken from a parent, or, in urgent necessity, from the operator himself, injected into the patient, will stop the hæmorrhage in some cases. In the last few years, blood transfusion has proven very successful and has saved the lives of many hæmophiliacs.

Syncope and Shock

Syncope is due to cerebral anemia, while shock is a condition of depressed vitality. It is more than likely that syncope is a forerunner, in a great many cases, of shock. I have classified two types of syncope: (1) Operative syncope, that is, fainting or collapse during the anæsthetization or operation; and (2) post-operative syncope. The latter type may occur several hours, or even a day, after the operation.

Operative Syncope.—This condition is frequently due to psychic reasons. It is strange to say, but syncope of this type is observed more often in the big, athletic fellow than in the frail, little woman. Syncope is sometimes caused by failing heart action. The musculature of the heart, not being able to drive the blood to the brain, causes a cerebral anemia.

It might be well to digress here for a moment, and take up the peculiar symptoms seen after the injection of procain-suprarenin. Many of us have noticed some untoward results immediately after, and sometimes during, the injection. While they are almost always of a transitory nature, nevertheless, they are most distressing to the operator and patient. Of course, a lot of these cases are psychic, and we can notice the patient paling, immediately

after the insertion of the needle, without discharging a drop of our solution. There are, however, a group of cases where the psychic element does not enter. The symptoms presented by these patients are: palpitation of the heart (tachycardia), pains across the lower lumbar region, sometimes abdominal pain, and frequently loss of power in the arms or legs, usually of only one side. The face becomes pale, the lips bluish, and the pulse rapid. Respiration is sometimes interfered with, and they have some difficulty in breathing freely. Of course, as was stated above, these symptoms are fortunately of short duration, and I have never seen a case, no matter how severe the symptoms, where I could not continue and complete the operation after a few moments' rest.

It is my opinion that the reason for these symptoms is the suprarenin in the solution. These patients are suffering from some endocrine disorder. They probably are unaware of this fact, and although they may suffer from some mild symptom do not pay any attention to it. The injection of the adrenalin brings out this disorder and causes the symptoms we see. It acts in much the same way as the Goetsch test for hyper-thyroidism. This test is the injection of adrenalin, and brings out certain definite symptoms in those suffering from an over-

secretion of the thyroid gland. These symptoms are almost identical with those witnessed after the injection of our procain solution; namely, palpitation. loss of muscular tone of the extremities, and lumbar and abdominal pain. I am firmly of the belief that wherever we see these in patients, after the injection of the procain solution, these patients are suffering from some endocrine disorder, probably hyperthyroidism, and that it is the adrenalin or suprarenin in the solution that brought them about. The two following cases are of interest:

"Miss B. F., age 35. Have injected this patient over a period of three years for various operations in the mouth, without any symptoms whatever. A short time ago, I had occasion to inject her again, and in two or three minutes after the injection she complained of palpitation and general muscular weakness of the legs and arms. In a few moments the symptoms passed off and she was well enough for me to continue the operation. However, it seemed strange that after all the injections she had had, this one should affect her so. On close questioning, she said that the tachycardia had lately been troubling her, but that she had not paid any attention to it, and also that of late she had been feeling very nervous. There is little doubt that she is suffering now from some endocrine dysfunction, probably

hyperthyroidism, and that the adrenalin in the solution had brought out the symptoms recorded."

The following case brings out clearly the rôle played by the adrenalin in a true case of goitre, and the symptoms were the severest I have ever seen:

"Miss R., age 47, suffered from an exophthalmic goitre. I injected 2 c.c. of a 2% procain-suprarenin solution, and in a moment or two she complained of severe pain in the abdomen and lower part of her back. The tachycardia was most distressing and the patient became greatly frightened. In two or three minutes the pain and palpitation passed off and I was able to proceed with the extraction."

The points that I wish to make clear in citing this case are the effects of suprarenin in cases of undoubted hyperthyroidism and goitre, and the rapidity with which they pass off. However, where we definitely know that the patient is suffering from this ailment we should be careful to reduce the adrenalin content of our solution. In some cases, the minutest amount of suprarenin will cause these symptoms, and if they should occur the operator need not be frightened, as they quickly pass away and do no harm. There really is no definite treatment for these patients, as far as we are concerned, except to allow them to remain quiet until they feel

easier, and if they are nervous, to give them a bromide.

Symptoms.—To return to the symptoms of syncope; they are paling of the face and lips; beads of cold perspiration break out upon the forehead, and the face becomes waxy and the nose elongated. It will be found that in mild cases of syncope, or the average faint, the pulse will remain strong, although a trifle accelerated. In the severer types, the pulse will be found to be weak, thready and very fast.

Treatment.—At the first signs of these symptoms, it is best to stop all operating and restore the patient. In most cases, placing the patient's head between their knees will cause the blood to rush to the anemic brain and restore consciousness. (Fig. 26.) When this has returned, a drachm of aromatic spirits of ammonia in half a glass of water will revive the patient sufficiently to continue the operation. No drug should be forced in the patient's mouth until consciousness has been restored, and the patient is able to swallow.

Where these measures do not succeed in restoring the patient, the faint may be assuming a more serious nature, and the condition may be approaching a stage of shock, or the heart may be failing. The patient should be stretched out in the chair

Fig. 26.—Method of reviving a fainting patient. The head is forced down between the knees.

with the head lower than the feet. Tight clothing is loosened and the pulse carefully observed. It will be found to be feeble and extremely rapid. It is also advisable to take the systolic blood pressure. This will be found to be low, and if it should fall below 90 mm. of Hg. the condition is serious. Hypodermic medication is now imperative. The most rapid of the stimulants at our command to-day is adrenalin chloride. Seven minums of the 1-1000 solution should be injected subcutaneously in the deltoid region of the arm. In many cases the patients have the sleeves of their clothing rolled down over their arms, and as quick action is necessary, the sleeve can be pushed up and the injection made in the forearm. Pituitrin can also be used in the same manner, but its action is slower than adrenalin, although more lasting. The action of adrenalin is rapid, but not of long duration, and other medication is indicated, to retain what has been accomplished by the adrenalin. Hot black coffee by mouth, provided the patient can swallow, strychnine sulphate, 1/60 gr. or camphor in oil, can be injected. As soon as sufficient recovery has been made the patient is carefully carried to a rest room and laid upon a couch. The feet are raised and the shoes removed. Warm blankets are wrapped about the patient and a hot-water bag placed at the feet.

This is done to increase the body heat, for in shock the body heat is greatly lowered, and in cases of failing heart, warm skin and extremities decrease the peripheral resistance to the heart, and lessen the work of this organ.

The systolic blood pressure should be taken from time to time, and a rise will indicate improvement. Where the blood pressure does not rise after treatment, or where it is becoming progressively lower, a physician had better be consulted, preferably the family doctor. The patient may have to be sent to a hospital, where more drastic treatment, such as saline infusion, or even blood transfusions can be instituted. Steadily decreasing blood pressure is indicative of progressive shock, or in some cases failing heart muscle.

If the blood pressure rises again, and the patient is feeling better, he can be allowed to return home, with the admonition to go immediately to bed and keep warm. He should also be advised to keep himself under the care of a physician for the time being.

Unless the extraction is absolutely imperative, the operation is deferred for a few weeks. In the meantime, the patient can consult a physician and be treated for whatever ailment might have contributed to the attack of syncope.

Post-operative Syncope.—This condition, while it does not occur frequently, is far more serious than that which takes place during an operation. The patient may leave the office with a strong pulse and feeling well, and several hours later collapse. These cases should receive the attention of the family physician, as they sometimes terminate fatally.

Probably the best treatment for them is body warmth, obtained by the method described above, and transfusion of saline solution. Morphine injections to induce sleep have proven beneficial. Crile advises the administration of morphine, given every hour until the respirations have reached twelve. However, it must be given with caution, and should not be administered if the finger nails are blue.

Adrenalin chloride is useful in raising the blood pressure, and can be added to the saline solution. Fluids are of value and are supplied by the infusions. We are not often called upon to treat these patients, but when the occasion arises, the dental-surgeon should be in a position to recognize it and suggest the proper treatment.

CHAPTER VIII

POST-OPERATIVE CARE

POST-OPERATIVE care is as important as the operation itself. After-care can be divided into:

1. Care taken by the operator.
2. Care taken by the patient at home.

The After-care Taken by the Operator.—No matter how simple the extraction has been, the patient should be advised to return the next day for observation of the wound. If the tissues are healing, the patient is dismissed with the admonition to return if any untoward symptoms should arise.

Some sockets heal slowly and sluggishly. There may be no pain, but just a lack of regeneration of the tissues. The cause of slow healing may be local, such as a low-grade infection of the tissues, or general, due to an alteration in the chemistry of the blood, as in the case of diabetes. Chronic infections like syphilis and tuberculosis also retard healing after extraction.

The treatment of slow healing depends upon the

cause. The patient in all cases should be referred to a physician for a general examination, including urinalysis and the Wassermann test. Locally, the socket can be lightly curetted to encourage bleeding, for which no anæsthesia is necessary, and cauterized with a 10 per cent solution of nitrate of silver, to stimulate granulation.

No treatment aids healing of oral tissues better and quicker than vaccines. I have often noted how quickly and painlessly sockets healed where vaccines were injected, concomitantly with the extraction of teeth, in treating cases of focal infection. It has been my practice to use mixed stock vaccines in all cases of sluggish healing. Formerly, they were injected in the deltoid region of the arm, but after visiting Dr. Goldenberg in his laboratory in Paris and seeing the merits of his vaccine, I now use it to the total exclusion of all others. The following case is illustrative of the value of vaccino-therapy in just these types of cases.

"Mrs. F., age 50. I removed the upper left central, lateral canine, first bicuspid and straightened the alveolar process. The operation was accomplished easily, but the patient had considerable discomfort afterwards. The sockets showed no sign of healing, even though they were stimulated with light curettement and applications of silver nitrate. She

was referred then to her family physician for a general examination, which was negative. I next used Goldenberg's vaccine, and after the first injection there was a marked cessation of pain and the wound looked better. By the fourth injection the wound was healing nicely, and the patient was entirely free from all discomfort. I continued with the injections until I had given her six. I then removed the upper right central, lateral, canine, and the first and second bicuspids, and did quite an extensive alveolar resection. There was no after-discomfort, and within one week a denture could have been inserted. Three weeks later, the patient had her permanent dentures. Contrast this last result with the first. The first wound took more than two months to heal; the second was healed in one week, and undoubtedly the success of this second operation was due to the use of vaccines."

In cases where a flap has been sutured, the condition of the circulation of the flap must be watched, and if the latter looks red and congested, the circulation is aided by gentle massage and applications of warm isotonic solutions, held in the mouth. The union of the flap must also be observed. If there is no union in five or six days, the parts should be re-anæsthetized and the edges of the flap freshened and resutured. The patient's health is inquired into

and a few injections of vaccine given to combat local infection. These measures will, as a general rule, hasten the union of the tissues

In cases of normal healing, the sutures are removed in four or five days.

After-care Taken by the Patient.—The patient should be advised as to the proper home treatment of any exigency that may arise, such as pain, swelling, and the prevention of infection of the operative wound.

For the relief of pain, I have found nothing better than aspirin. Two five-grain tablets every three hours, with plenty of water, is the dosage prescribed. If the aspirin has a tendency to upset the digestion, a teaspoonful of bicarbonate of soda can be added to the water. However, there are those patients that cannot take aspirin at all, and to them I am in the habit of prescribing pyramidon, five grains every three hours. In cases of very severe pain it might be necessary to give one-eighth of a grain of morphine hypodermically. Warm mouth washes also give relief.

Where a patient is suffering from nervous irritability and is restless, there is no drug I have found more efficient, than the triple bromides, made by Burroughs, Welcome & Co. One tablet is dissolved in a half glass of water, and can be

taken every four hours until the patient feels their effect.

To control swelling, cold applications on the outside of the face are most gratifying. Swelling is apt to follow extractions, especially where any chiselling has been done. An ice-bag kept over the œdematous parts for ten minutes every hour, will relieve the congestion of the tissues. Another soothing, cold dressing is a tablespoonful of the Tincture of Hammamælis in a glass of water. A cloth is saturated with this solution and kept over the affected area.

For the prevention of post-operative infections of the wound, mouth washes are prescribed. For the ordinary simple case of extraction, warm saline solutions will answer the purpose. They can be prescribed in the form of a teaspoonful of salt to a glass of warm water. This solution is soothing and cleansing, and promotes absorption of the inflammatory exudates.

Where extensive operations have been performed, or where several teeth have been removed, any one of the following formulæ in recommended:

℞

Acidi Salicylici	gr. xxv.
Glycerini	ʒ v.
Aquae Menthae Piperitae	ʒ vi.

℞

Acidi Borici ..... ʒ ss.
Potassii Chloratis ..... ʒ i.
Aquae Menthae Pip. ..... ℥ vi.

℞

Sodii Chloridi .....
Sodii Boratis ..... aa ʒ ss.
Glycerini ..... ʒ iss.
Aquae Gaultheriae ..... ℥ vi.

If infection of the wound has taken place, which is usually indicated by a graying of the edges of the socket and pain in the operative field, a mouth wash of mercuro-chrome, 220 soluble, is given. I do not prescribe this drug, but supply the patient with a little of it, with instructions to put just enough crystals in a glass of water to give the water an orange color. Two or three crystals will answer this purpose. The action of this drug is rapid, and is the most efficient mouth wash I have tried.

CHAPTER IX

VACCINO-THERAPY IN DENTAL SURGERY

THE value of vaccines in the routine practice of dental surgery is so great that I have devoted a chapter to their especial consideration. Let us briefly review the theories of infection and immunity, upon which this method of therapy is based.

Infection.—When micro-organisms have passed the normal barriers of the skin or mucous membranes, and have invaded and proliferated in the deeper tissues, the process is spoken of as infection. Before infection takes place there are two preliminary steps; namely, contamination and invasion.

Contamination is the presence of bacteria on the surface of an article or substance, while *invasion* is the penetration of bacteria without proliferation, into the deeper tissues. We cannot have infection without invasion, and we cannot have invasion without contamination. However, unless the micro-organisms proliferate, infection does not take place. This is extremely important to bear in mind.

Where we have infection caused by bacteria gaining entrance into the individual from outside

sources, we have what is known as *exogenous infection,* in contra-distinction to *endogenous infection,* caused by bacteria already present in the tissues themselves.

Avenues of Infection.—There are various routes whereby bacteria can gain entrance to the body. These avenues are:

1. Skin and mucous membrane.
2. Respiratory organs.
3. Digestive tract.
4. Genital organs.
5. Placenta.

Normal Defenses against the Invasion of Bacteria.—Nature has provided a number of ways to protect the body against the invasion of micro-organisms. They are known as the normal defenses of the body, and any change in these defenses predisposes the tissues to infection. They are:

1. Surface layer of epithelium, which offers mechanical obstruction.
2. Surface discharges, such as saliva. These discharges act by means of mechanically washing away the bacteria. They also are supposed to possess a certain amount of germicidal power, and it is claimed there are anti-bodies present also in these discharges.
3. Cells of certain excreting glands are thought to have germicidal power.

Mechanism of Invasion.—Any disturbance of the foregoing defenses will permit of invasion of the tissues. Besides these, there are certain bacteria that have the power of breaking down the natural defense of the tissue, such as the diphtheria bacillus. Infection can also be started by the so-called wandering cells carrying micro-organisms to various parts of the body. These are known as *cryptogenic infections.* Leucocytes, in performing their phagocytic functions, sometimes act in the same way as these wandering cells.

However, invasion does not mean infection, as was stated before, and consequently the latter process can only take place when:

1. The micro-organisms are virulent.
2. When they invade the body through appropriate channels.
3. When they are in sufficient number.
4. When the host is susceptible.
5. When the bacteria are able to resist the defensive powers of the host, through agencies aside from their offensive forces.

The virulence of a micro-organism is its disease producing power, and is dependent upon its *toxicity* and *aggressiveness.* The toxicity is the kind and amount of the poison elaborated by the bacteria. There are two types of poisons or toxins; the *endo-*

genous, which are those that diffuse into the surrounding tissues and are readily absorbed; and the *exogenous,* which are contained in the micro-organism itself, and are liberated only upon the death of the cell.

Aggressiveness is the power of a micro-organism to enter, live and multiply in the body fluids.

Where infection by more than one specie of bacteria takes place, it is known as a *mixed infection.* Generally speaking, all infections of the mucous membranes are mixed infections.

Where micro-organisms originate in a primary focus and are carried via the blood and lymph to other parts of the body, there to set up metastatic lesions or secondary foci, the process is known as *focal infection.*

Immunity

Immunity is the effective resistance of the body against infectious micro-organisms and their products.

Theories of Immunity.—The two chief theories to-day are the cellular theory, or the Theory of Phagocytosis of Metchnikoff, and the humoral theory, of which the Side Chain Theory of Ehrlich is the most important.

Phagocytosis.—The leucocytes and other cells

were regarded by Metchnikoff as being able to engulf living, as well as dead, bacteria and cellular debris. These cells were called phagocytes and were divided into two classes: namely, the *microphages* and the *macrophages*. The microphages consisted chiefly of the polymorphonuclear leucocytes, while the macrophages were made up of the large mononuclear lymphocytes, ameboid cells of the spleen, alveolar cells of the lungs, endothelial cells of serous cavities and lymph spaces, bone corpuscles, giant cells of bone, and embryonic connective tissue cells. The most important of the phagocytes are the polymorphonuclear leucocytes and the large lymphocytes.

These cells are attracted or repelled from the site of infection by the action of a chemical agency, produced by the bacteria, which exerts a force known as chemotaxis. That force that attracts the cell is *positive chemotaxis*, while the repellant force is *negative chemotaxis*.

There is also a substance in the blood known as an *opsonin*, which changes the bacteria so that they become susceptible to the phagocytes. In other words, opsonins are anti-bodies that render bacteria vulnerable to phagocytes.

The Side Chain Theory of Ehrlich.—Ehrlich compares the body cell to the benzol ring of chem-

istry. That, from the central molecule of the cell there radiates a number of processes or side chains, known as *receptors*. These receptors are supposed to have a distinct affinity for toxins circulating in the blood. The toxin molecule is also supposed to be made up of two portions, the *haptophore* portion, which combines with the receptors, and the *toxophore* portion, in which lies the poisonous action.

The toxin molecule floating in the fluid surrounding the cell, becomes firmly locked to one of the receptors by means of its haptophore portion. Having combined with the side chain of the cell, the toxin may be potent enough to kill the cell, and if a large number of cells are so destroyed disease and probably death may follow. On the other hand, although one receptor may have been destroyed, the cell is capable of repairing its loss, and producing more receptors. In fact, the receptors may be produced in such excess that they find no room for attachment to the cell, and are thrown into the blood stream, there to circulate. These receptors, or anti-bodies, as they are now called, have the power of combining with the original toxins that produced them and render them harmless. These toxins that stimulate the formation of receptors are known as *antigens*. In diphtheria, the

antigen is a soluble toxin, and the cast-off receptors stimulated by them are the anti-toxins.

As new discoveries were made, Ehrlich enlarged his theories to embrace them, but always upon his fundamental principles. To-day we have anti-bodies or receptors of three orders. The *first*, or original, is *anti-toxin*. The *second* order comprises the *agglutinins* and *precipitins;* and the *third*, the *hæmolysins, bacteriolysins* and the *cyto-toxins*.

Antigens and Anti-bodies

Antigens are substances that cause the formation of anti-bodies in the body fluids. There are specific and non-specific antigens. Those substances that cause the formation of anti-bodies, but are hostile to them alone, are known as *specific antigens*. Now we know that some foreign substances may act, if injected, as a general stimulant upon the body cell, to produce anti-bodies, not related to the agents injected. These foreign substances are *non-specific antigens*, and upon this theory non-specific protein therapy is based.

Antigens are colloids, and of a protein nature. Every protein can act in some degree as an antigen, and anti-bodies can be produced not only by bacteria and their poisons, but also by such proteins as serum of other animals, egg-albumen, milk, etc.

Anti-bodies.—Those substances produced by the cells in reaction to some antigen are known as *anti-bodies.* They are found in the various fluids of the body, but the greatest amount is in the blood. Anti-bodies are commonly found in inflammatory exudates also.

The tissues concerned in their production are thought to be the leucocytes and blood-forming organs, such as the spleen, lymphatic tissue, and bone marrow. The liver is also believed to play some part in their formation.

There are those that think there is a local production of anti-bodies, that is, immune substances are formed at the site of infection. One of the chief exponents of this conception is Besredka of Paris, and upon this theory, the vaccine of Goldenberg is based.

Besredka believes that bacterial infections have a tendency to electively attack certain organs. For example, the micro-organisms of anthrax and small-pox attack the skin, while those of typhoid and dysentery attack the intestinal mucosa. He, therefore, concludes that tissues that are liable to certain infections can confer immunity to these infections. This is proven to be true by experiment. If, for instance, the bacteria of anthrax is injected into a guinea pig, either intramuscularly or into the peri-

toneal cavity, no anti-bodies are formed, and the animal is not immunized to an infection of anthrax. But if an anti-anthrax vaccine is introduced into the skin, the guinea pig is rendered immune to these micro-organisms. This theory of local immunization and production of anti-bodies shows also that the route of introduction of a vaccine is a matter of importance, and that the vaccine should be made to follow the same path taken by the infective agents.

Types of Immunity

There are two kinds of immunity: *natural* and *acquired.* Acquired immunity is again divided into *active acquired immunity* and *passive acquired immunity.*

Natural Immunity.—This is the type of immunity inherent in an animal or person. It is, however, never absolute.

Active Acquired Immunity.—Immunity that is brought about by activity of the cells, as a result of having had a disease, or through artificial inoculation with a vaccine made up of the causative bacteria. It is brought about by accidental infection, by inducing the disease by artificial inoculation of the disease itself. This is an obsolete and dangerous method. And, thirdly, by vaccination.

Passive Acquired Immunity.—This is the immunity acquired by an animal or person, wherein their cells do not form the anti-bodies, but they are introduced in a serum taken from some other animal, which has been rendered immune to the infection and has produced the specific anti-bodies. Examples of these serums are diphtheria anti-toxin and tetanus anti-toxin.

Vaccines

The commonest method of procuring active acquired immunity is by the injection of vaccines. Wright's definition of a vaccine is, "sterilized and enumerated suspensions, which furnish when they dissolve in the body, substances which stimulate the healthy tissues to a production of specific bacteriotropic substances, which fasten upon, and directly or indirectly, contribute to the destruction of the corresponding bacteria."

They are made by first procuring the infected material, and preparing pure cultures of the bacteria present, then making a suspension of these bacteria in normal saline solution, and killing them with heat or a chemical. Finally, they are counted so as to get the proper dosage. So many bacteria are contained in 1 c.c. of the solution. It is good practise to prepare a vaccine in which each c.c.

contained the maximum number of the bacteria desired.

Vaccines may be *stock* or *autogenous*. An autogenous one is made especially from the bacteria procured directly from the patient, while stock vaccines are prepared from bacteria not taken from the patient, but having the same characteristics. They are prepared in advance and are always available. Opinion is divided as to the relative merits of autogenous and stock vaccines. If possible, autogenous vaccines are preferable. However, it is not always possible to recover the identical microorganism responsible for the disease, and in acute infections, such as cellulitis, pneumonia, etc., much time would be lost waiting for the preparation of an autogenous vaccine. Hence, stock vaccines are indicated in these cases. In mixed infections, such as occur in the oral cavity, stock vaccines are of as much service as autogenous ones. For protective immunization, stock vaccines are also used. As far as non-specific immunization is concerned, stock vaccines are as desirable as the autogenous.

Sensitized Vaccines are those composed of living bacteria immersed in their own immune serum. They possess no advantage over the ordinary type and are little used.

When only one strain of a bacterium is contained

in a vaccine, it is *monovalent*. Where several strains of the same bacterium are used, the vaccine is *polyvalent*. If the vaccine is composed of different kinds of micro-organisms, it is known as a *mixed vaccine*.

Generally, stock vaccines should be polyvalent, and those used in the oral cavity, mixed.

Vaccino-therapy

Vaccino-therapy aims at artificially creating antibodies in the tissues, to create immunity to some definite infectious process.

The Method of Introduction of Vaccines.—In the vast majority of cases, vaccines are given sub-cutaneously. The most favorable site is the deltoid region of the arm, near the insertion of the muscle. The syringe and needle are boiled, and the skin painted with iodine and then alcohol. The skin is picked up between the thumb and forefinger, and the needle plunged under it. (Fig. 27.)

The effects of the inoculation are: *local*, that is, the reaction taking place at the site of injection; *focal*, the reaction taking place at the lesion; and *constitutional*. This is the general reaction the patient has, such as headache, rise in temperature, and general lassitude. These general reactions are usually due to an excessive dose, but may occur

in patients that previously showed no reactions at all.

The local and constitutional reactions are mostly due to the influence of the protein constituents of the vaccine.

The intervals between doses depends upon the reaction of the last one. It is better to wait too

Fig. 27.—Technique of making a hypodermic injection in the deltoid region of the arm. This method is the same for the introduction of vaccines, narcotics or stimulants.

long than to inoculate too quickly. The dosage varies with the following factors: Whether the infection is acute or chronic; the nature of the micro-organism; and the age of the patient.

In acute infections, the dose is small and frequently given, while in chronic infections the dose is larger, but administered at longer intervals. It is always better, when in doubt, to give small doses and watch the reaction. Children tolerate fairly large doses, but the dosage should depend upon the weight and not the age.

In the treatment of oral infections, stock vaccines are used, and they should contain streptococci, staphylococci, pneumococci, and the micrococci catarrhalis. Each c.c. should be made up of equal amounts of these organisms, to make one billion, and the initial dose is 0.1 c.c. Subsequent injections are given at intervals of from five to seven days, gradually increasing the amount until 1 c.c. is reached.

Goldenberg's Vaccine.—Basing his treatment upon the local immunization theory of Besredka, Goldenberg of the Institut Pasteur de Paris formulated a vaccine that could be injected directly into the oral mucosa. It was necessary for him to prepare a concentrated vaccine, since large quantities of solution could not be conveniently used in the

mouth. Also, he had to eliminate the local reaction as much as possible. This was accomplished by the following technique. The usual solution, normal saline, in which the bacteria are suspended, was replaced by a substance, itself active. This was accomplished by making a mixture of the bacteria procured from some active infection in the mouth, such as suppurative periodontoclasia. This mixture was then divided into three unequal parts. One-half was used as the excipient to replace the normal saline solution. The microbes in this portion were treated with a 10 per cent solution of caustic soda, for twenty-four hours at 37° C., and the solution was then neutralized with hydrochloric acid.

One-quarter of the original mixture was next heated to between 60° and 70° C. to kill the bacteria, and the remaining part of the original mixture was treated with formol for the same purpose. The last two portions were emulsified in the excipient and 0.5 per cent phenol was added. This fluid was now so diluted that each c.c. contained 20,000 million bacteria. The dosage was arranged in drops, each drop corresponding to 0.05 c.c. and contained about 1,000 million organisms.

Technique of Its Use.—The injection is made in the muco-buccal fold. (Fig. 28.) Care must be taken not to inject deeply, as in the administration

of a local anæsthetic. The needle should just barely penetrate the mucosa, so that it can be seen beneath the tissues. When the fluid is discharged, there should form a wheal. The most convenient place

Fig. 28.—Technique of making an intra-oral injection of Goldenberg's vaccine. The needle is barely inserted beneath the mucous membrane in the muco-buccal fold.

for injection is in the muco-buccal fold about the upper or lower canine regions.

The first dose consists of one drop, with an interval of four days before the second injection. The second dose is two drops, choosing another site

for the injection. It is my habit to start over one cuspid, and make each injection over another cuspid, returning to the first place on the fifth injection. The third injection is made forty-eight hours later, the dose consisting of three drops. Dr. Goldenberg advises injecting in several places, where the dose is more than three drops. This is based on the theory that the more tissue utilized, the more anti-bodies manufactured. I usually inject in two places where the dose is more than three drops.

The injections are now made until six drops are reached. This is the maximum dose, and five injections of six drops each are made at intervals of forty-eight hours. The course of treatment comprises ten injections. However, there is no definite rule. Some cases require only five or six injections, while others show no improvement until twelve or more have been given. If, during the course of treatment, excessive reaction should follow an injection, three or four days are allowed to elapse, and the same dose repeated. If no reaction then occurs, increase in the dosage can be made.

There is rarely any reaction following the use of this vaccine. Constitutionally, there is practically none at all, while locally there might be a slight

swelling at the point of injection, rarely accompanied by annoying pain.

Indications for the Use of Vaccines in Dental Surgery.—Vaccino-therapy can be used in the practise of dental surgery, wherever infection exists in the oral cavity. It is especially indicated in:

1. Osteitis of the socket (Dry Socket).
2. Slow healing of operative wounds.
3. Pericoronal infections about lower third molars.
4. Suppurative Periodontoclasia (Pyorrhea Alveolaris).

Conclusion.—While vaccines are not panaceas for all ailments, if intelligently used, they offer us a most valuable adjunct to our surgery.

CHAPTER X

BLOOD-PRESSURE—PULSE TEMPERATURE

Blood-Pressure

One of the most useful adjuncts to the dental surgeon in making a diagnosis as to the fitness of a patient for operation, is the measurement of the blood-pressure.

Definition.—Blood-pressure, according to Hirschfelder, is the term used to indicate the pressure which the blood is exerting upon the walls of the vessel in which it is to be measured (lateral pressure), or upon the column of blood ahead of it, in the direction in which it is flowing (end pressure).

In understanding blood-pressure, we must determine three factors: Systolic, diastolic, and pulse pressures.

Systolic pressure represents the total energy expended by the heart.

Diastolic pressure is the entire load of pressure borne by the whole arterial system during systole. In other words, it is the pressure in the arterial system minus the force of the ventricular systole.

Pulse pressure represents the efficiency of the heart and indicates the extent to which it overcomes the peripheral resistance.

For ordinary routine dental practice, determination of the systolic blood-pressure is all that is necessary.

In the determination of blood-pressure, we use an instrument known as a *sphygmomanometer.* There are two types of this instrument in use to-day. The difference between them is that one measures the pressure by means of a column of mercury, while the other has a spring gauge of the arænoid barometer type. For dental use, the gauge manometer is best, as it is more portable and can conveniently be adjusted to the patient while seated in the operating chair.

The sphygmomanometer is composed of three parts: The sleeve portion, in which is the rubber bag; a pump with a release valve, and the manometer. The idea of the instrument is to determine the amount of force, measured in millimeters of mercury (mm. Hg.), necessary to obliterate the lumen of a given artery.

Technique of Application.—The sleeve is applied to the arm above the elbow. It is not important which arm is used, although some authorities advise the use of the left arm. The arm should be bare,

but this is often difficult to obtain, especially where we want to make a hasty examination of the blood-pressure in cases of collapse or shock. Where we do take the blood-pressure over clothing, 10 to 15 mm. Hg. should be deducted from the amount registered on the gauge. The portion of the sleeve containing the bag is placed on the arm first and the rest of the sleeve wound about in the manner of a bandage, tucking the last portion under one of the folds. The pump is attached to one of the tubes leading from the bag and the manometer is attached to the other. (Fig. 29.)

Methods of Taking Blood-Pressure.—There are three recognized methods:

1. Auscultatory
2. Oscillatory
3. Palpatory

The auscultatory method is the most accurate of the three, although the palpatory one will answer all the purposes of the dental surgeon. For determination of the diastolic pressure, the only accurate method is that of auscultation. It is rarely necessary for the dentist to take this pressure, but there may arise some occasion when it might be desired. Consequently, it will be necessary to give a brief description of the method of auscultation.

The stethoscope is used in this method. The sleeve and compression bag are adjusted to the arm above the elbow, and the bell of a binaural stethoscope placed over the brachial artery, right below the bend of the elbow. The radial pulse is also

Fig. 29.—Showing technique of taking blood-pressure by the palpatory method using the spring gauge type of sphygmomanometer.

sought. Air is pumped into the compression bag until the pulse at the radial artery disappears. With the stethoscope now at the brachial artery, a little more air is pumped into the bag and then gradually released. When the pulse returns at the wrist, a distinct tapping will be heard in the stethoscope, and the reading on the gauge, when this tapping first appears, represents the systolic pressure. This is known as phase 1. As the air continues to escape, a murmuring sound is now heard through the stethoscope (phase 2), and as the air further continues to escape, the murmur becomes sharper (phase 3). Finally, the sound fades away and disappears (phase 4). Just as the sound begins to fade away, the reading is taken on the gauge and this represents the diastolic pressure.

To get the *mean pressure,* we add the systolic and diastolic pressures together and divide by two.

The *pulse pressure* is obtained by subtracting the diastolic from the systolic pressures.

As was stated before, for ordinary routine dental practise the determination of the systolic pressure by palpation will suffice. The technique is as follows:

The sleeve, gauge and pump are adjusted as described above, and the radial artery felt for. The compression bag is now inflated until the pulse at

the wrist disappears. The air is continued into the bag for 20 or 30 mm. Hg. more and then released slowly. At the moment when the pulse returns, the reading on the gauge is recorded, which represents the systolic blood-pressure.

Normal and Abnormal Blood-Pressure.—A systolic pressure ranging from 105 to 145 mm. Hg. is regarded as normal in adults. In children it ranges from 85 to 110 mm. Hg. The systolic pressure in women is about 10 mm. Hg. lower than in men.

A normal diastolic pressure is between 25 to 50 mm. Hg. lower than the systolic, while a normal pulse pressure ranges from 25 to 50 mm. Hg.

A systolic pressure below 100 mm. Hg. or above 150 mm. Hg. is abnormal, while a diastolic pressure above 105 mm. Hg. is pathological. A pulse pressure below 25 mm. Hg. and above 50 mm. Hg. is abnormal. In discussing variations from the normal in blood-pressure, we recognized two types: High blood-pressure, or hypertension; and low blood-pressure, or hypotension.

Hypertension.—This may be transitory, when due to physiological causes, such as emotion, menstruation, after-eating, during defecation, and also atmospheric conditions. Persistent hypertension is seen in arterio-sclerosis, kidney diseases, uræmia, aortic regurgitation, brain tumors, and alcoholism.

Hypotension may also be physiological, but this is again transitory. Micturition, exercise, hunger, and atmospheric influences, all contribute to temporary low blood-pressure. Permanent hypotension is usually associated with chronic infectious diseases, such as tuberculosis. In active infectious conditions, like typhoid, pneumonia, scarlet fever, diphtheria, and sometimes rheumatism, the blood-pressure is also low.

Endocrine dysfunction often causes permanent hypotension, especially any deficiency in the secretion of the adrenal glands. In shock, the blood-pressure is extremely low, and the lower the blood-pressure the more serious the shock.

Pulse

It may seem superfluous to discuss the pulse, yet there are a great many who cannot definitely tell what the pulse is, or its significance. And it might not be amiss to state there are those who cannot accurately take it.

Definition.—The popular conception of the pulse is the expansion of an artery due to the blood discharged into the aorta. This, according to Mackenzie, is not the case. Physiologists claim that the expansion in an artery is so slight as to have its existence denied. In large arteries, there

may be some expansion, but in such vessels as the carotid and radial, it is so minute as to be negligible. What is recognized to-day as the pulse is "the sudden increase of pressure within the artery, pressing against our finger, when we compress the artery" (Mackenzie). Each sudden increase represents the ventricular systole.

Method of Taking Pulse by Digital Examination.—Any superficial prominent artery can be used for the taking of the pulse. However, to do this properly it is necessary to compress the artery against a bone. The anæsthetist uses the temporal artery as it passes over the zygoma in front of the tragus of the ear. For all general purposes, the radial artery, as it passes over the end of the radius, is the one of choice. The tips of the index, middle, and third fingers are placed on the artery, and the thumb is placed on the under side of the wrist.

What to Note in Examining the Pulse.—The pulse conveys to us certain information by noting the:

1. *Rate per Minute.*—The number of beats per minute can conveniently be counted by noting the number of beats in fifteen seconds and multiplying by six. This method is only used if we are certain the patient is well. If we are at all suspicious of

the condition of the patient, the pulse should be counted over a period of a full minute.

2. *Rhythm.*—Whether the pulse is regular, irregular or intermittent.

3. *Size, force and character* of the pulse. That is, whether the pulse is large, moderate, or small; deliberate, or sudden; strong, or weak; dicrotic.

4. *Resistance of the artery to pressure.*

Rate.—The pulse varies greatly, according to age. In the new-born child it is between 135 and 140; at one year, from 120 to 130; at two years, 105; at four years, 97; at ten years, 90; at fifteen years, 78; and from twenty to middle adult life, 70 to 72. These figures are not absolute, and the rates vary in perfectly normal people. The rate is influenced by taking exercise, eating, nervousness, pain and fever. We must not lose sight of the fact that the majority of patients coming to our offices are highly excited, or in pain, and we are most apt to find the pulse rate in these people rapid. Fear causes paralysis of the vagus nerves, and consequently increases the heart rate, while fever also accelerates the rate, by virtue of the heat acting as a stimulant to the heart. Hyperthyroidism and goitre are accompanied by an extremely rapid pulse. In collapse the pulse rate is also very fast.

Intermittency and irregularity of the pulse is

often seen in cases of ventricular fatigue, sometimes accompanied by high blood-pressure. Blocking of the contraction wave in the bundle of His causes irregularity of the pulse. This is due to an overdose of digitalis, disease, or toxemia of acute infections.

Character, Size and Force of the Pulse.—The volume of the pulse is due to the amount of blood sent out from the heart at each systole, and also to the ability of the aortic valves to prevent regurgitation.

Hypertrophy of the heart and stimulation of the vagi through fear, etc., causes a *large full pulse.* In aortic regurgitation we find a *short sharp pulse,* known as the "trip hammer", or "Corrigan Pulse".

In mitral regurgitation, or mitral stenosis, the pulse is *small* in volume because the left ventricle cannot receive enough blood to throw out into the aorta.

Degeneration of the heart muscle, as well as the infectious fevers, result in a seemingly large wave, due to relaxation of the arterial walls. However, the pressure is low and the rate rapid.

In aortic stenosis, we find the pulse *small,* and there is delay in its transmission to the wrist. Great *feebleness* is often associated with dilatation without hypertrophy, myocardial degeneration, both

chronic and acute, and exhaustion of the heart muscle in acute diseases.

A dicrotic pulse is one in which the second beat comes upon the first before the latter is completed. It is seen in some cases of fever.

The resistance of the artery to pressure often indicates the condition of the artery wall. This pressure can be determined by pressing the vessel against the end of the radius. By rolling the artery under the fingers, a healthy one can be told from one that is diseased. A normal artery, when it has been compressed, can hardly be felt after the pulse wave has left, while a pathological one will feel more or less hard, like a piece of rubber tubing. There may be either fibroid or atheromatous degeneration present. A pulse that requires a great deal of pressure to obliterate is indicative of high arterial tension, or one of the aforementioned degenerations. High tension and arterial hardness must be distinguished. Both can be present together or one can be present without the other. Calcareous deposits can be felt by moving the fingers along the long axis of the artery.

Fever and Temperature

We often hear of a patient having fever, or running a high temperature. What is really the

significance of these terms and what is their physiology and pathology?

Definition.—Fever is the reaction of the previously healthy body against the organisms of disease and their products (Jack). Adami says that fever is the process of adaptation to such toxic agencies as can be neutralized by the development of anti-bodies.

It is a protective reaction, and is indicative of the resistance of the body.

Pathology — General Changes. — While certain fevers may be provoked by specific agencies, mostly bacterial, yet the general changes taking place in the body are usually the same, regardless of the infective agent.

1. The blood is dark and more fluid, with a decrease in the erythrocytes. However, there is an increase in the leucocytes (leucocytosis).

2. The muscles are darkly colored, and show granular degeneration.

3. The heart is softened and dilated.

4. The internal organs are softened and congested, especially the spleen, liver and kidneys.

5. The lungs may be congested. This is usually not so much due to the fever process, as it is to the position of the patient (Hypostatic Congestion).

Physiology of Fever.—The toxins exert not only

a direct influence upon the tissues themselves, but also on the heat-regulating system in the brain and cord. This heat-regulating mechanism controls not only the heat production, but also the heat loss of the body. The excess heat is due to the disturbance of the heat-regulating mechanism, and also to the increase in tissue waste, caused by the destruction of the cells by the toxins. The excretory organs being congested and swollen, this waste cannot be excreted from the body. There are also the following secondary disturbances present in fever: Headache and delirium, or coma and prostration due to a disturbance of the central nervous system. All excretions except sweat are diminished. The urine is scanty and frequently contains albumen. There is little saliva, and the mouth and tongue are dry. Respiration is accelerated, due to stimulation of the respiratory centers, and the pulse is full and rapid, because of the stimulating effect of heat on the heart. The pulse may also be dicrotic and soft.

Excessive heat production with diminished loss of heat sometimes causes a spasm of the cutaneous vessels, which produces a sense of cold and shivering, accounting for the chills often seen in the onset of fevers. The chill passes quickly, as soon as the spasm produces enough heat to warm the skin.

Types of Fever.—We recognize three types of fevers: The *continual,* where the temperature remains above normal throughout the illness—for example, pneumonia; *remittent,* where the temperature is always above normal, but where it fluctuates during the day—for example, tuberculosis; *intermittent,* where during some time in the day the temperature returns to normal or subnormal —for example, malaria, occasionally pyæmia.

The onset of fever may be sudden, as in pneumonia, grippe and some acute pyogenic infections; or it may be gradual, coming on with an evening rise of temperature, increasing a degree or so, for successive days, as in chronic infections.

The fever may decline rapidly by *crisis,* or gradually by *lysis.*

Temperature.—By temperature is meant the degree of sensible heat or cold. The instrument used for the measurement of this degree is the thermometer. In the practise of medicine and dentistry we use what is known as a clinical thermometer. In this country it is graded in terms of Fahrenheit, and ranges from 92° F. to 110° F. The temperature can be taken by mouth, axilla or rectum. In dental practice, temperature by mouth is most advisable. It is taken by placing the end

of the thermometer containing the mercury well underneath the tongue, and having the patient close the lips, not the teeth.

Normal temperature by mouth is 98.6° F., although in summer it may reach 99° F. Anything above this point is regarded as fever, and below as sub-normal. Temperature by rectum is somewhat higher. In acute alveolar abscess, the temperature may reach 104° F. A rise in temperature is always indicative of infection, usually of bacterial origin, although occasionally in typhoid fever, it may be sub-normal.

In shock, hæmorrhage and disturbance of some of the endocrine glands, the temperature is sub-normal.

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