A GUIDE TO CARE/MAINTENANCE OF SURGICAL INSTRUMENTS

1. Preparation For Disinfection And Cleaning

Disinfection of soiled instruments not only helps to preserve the instruments themselves but also serves to protect those persons responsible for their transportation and cleaning. Wherever possible, instruments should be disinfected and cleaned immediately after use. Any soiling left to dry will make eventual cleaning much more difficult and could result in damage to the instruments. If necessary, instruments should be taken apart, allowing the disinfectant to cover all surfaces.

For disinfection of the instruments either humid heat or chemical disinfection can be used. Humid heat is preferable providing the instruments are suitable for treatment in this manner.

Occasionally, corrosive caustic agents and medicines (e.g. silver nitrate, iodine preparations, albotyl and mercury components) are used in operations and these substances have to be removed immediately.

Under no circumstances must instruments be stored in physiological saline solution as prolonged contact causes pitting and rust.

Undue "dropping" can cause damage to the instrument. Hard metal tips on scissors may be chipped or small, delicate clamps can be deformed. In order to avoid this, carefully handle and deposit the instruments after use.

To avoid encrustation and corrosion, in case of removal in dry condition and return to CSSD, the instruments must immediately be subject to machine treatment. For this treatment, deposit the instruments on suitable trays, e.g. perforated sterilizing trays. For effective cleaning, hinged instruments have to be opened (such as scissors, clamps, gouge forceps).

Instruments, which are subject to machine treatment, have to be immersed into a combined disinfecting and cleaning agent.

For removal in wet condition and return to CSSD use only non-corrosive agents in prescribed concentrations. Water alone is not sufficient! The instruments have to be fully covered by the solution.

Instruments should never be left overnight before cleaning as the risk of causing permanent damage increases with the length of time between use and preparation.

Handles and cables for HF-surgery have to be prepared like surgical instruments.

Microsurgical instruments require special preparation, and for this reason have to be deposited on racks or suitable holding devices. Dental materials, such as filling material, adhering to dental instruments have to be removed directly after use as otherwise there is the risk of hardening and/or corrosion.

Rotating dental instruments, such as burrs, drills, and grinding tools, have to be separated and stored in special containers or holding devices; such instruments have to be prepared separately.

If possible, surgical motors have to be dismantled into their components immediately after use; follow the instructions of the manufacturer. Surfaces of the various parts have to be wiped with a lint-free cloth, impregnated with a disinfecting and cleaning agent, or sprayed with a disinfection spray in order to avoid blockages and encrustations.

Simple tools can be prepared like surgical instruments.

Tubing sets for cooling liquid and spray nozzles have to be rinsed immediately

with water from the rinsing bottle and checked for leakage (visual control, see chapter "inspection").

Prior to preparation, rigid endoscopes have to be dismantled according to the manufacturer's instructions. Optical equipment has to be placed in special containers.

In the case of flexible endoscopes, the insertion part has to be wiped with a lint-free cloth immediately after use. The cloth should be soaked in instrument disinfectant, which should contain either a suitable detergent component or a cleaning intensifier suitable for disinfectants.

In order to avoid encrustations and blockages, the extraction channel and any other additional channels have to be rinsed with the same solution. The air/water channel has to be rinsed with water from the rinsing bottle.

Prior to further processing, the leak test has to be carried out according to the instructions of the manufacturer. This allows for the detection of leaks and perforations in good time and avoids expensive subsequent damage caused by the penetration of fluids.

A damaged endoscope together with a fault description has to be returned immediately to the manufacturer.

Cleaning and disinfecting of endoscopes should preferably be done in automatic machines.

Dismantle elastic instruments and breathing systems according to the manufacturer's instructions. Cones, Sealing surfaces, thread connections and valve plates have to be carefully handled and protected against mechanical damage.

Prior to preparation, completely remove breathing lime from the absorbers. Data readers have to be prepared only according to the manufacturer's instructions.

2. Manual Disinfecting And Cleaning

For manual preparation instruments have to be immersed into a combined disinfecting and cleaning solution with proven disinfecting effect.

The instructions of the manufacturer have to be strictly followed regarding concentration, temperature and induction time. Special attention has to be paid to the manufacturer's instructions with regard to material compatibility of instruments not made of high-grade steel.

Use fresh disinfecting and cleaning solutions every day. The following problems may occur due to using the same solution for too long:

- risk of corrosion due to soiling
- risk of corrosion due to increasing concentration caused by evaporation
- decrease of disinfecting effect due to excessive dirt concentration

Instruments with a narrow lumen (tubings, cannulae) or with cavities are generally difficult to prepare. One must, therefore, take care that the passages are free and that the inside is completely in contact with the solution.

If powdered products are used, completely dissolve the powder first. Only then should one immerse the instruments since undissolved particles may lead to clogging of the narrow lumen and discoloration of the instruments.

After chemical disinfection and cleaning, the instruments must always be rinsed well under running water. Any residue has to be removed manually (no metal brushes, no scouring agents). In order to avoid water spots, a final rinsing with demineralized water is recommended. Finally, the instruments have to be dried immediately.

Water on the surface of elastic instruments made of rubber or plastic

may cause white spots to appear which can only be removed by drying.

If, after manual cleaning, instruments are chemically disinfected instead of being sterilized, a separate disinfectant has to be used.

The instruments must then be rinsed thoroughly with sterile demineralized water.

If pneumatic air is used for drying, make sure that the air flows through a sterile filter.

Preference should be given to manual preparation of microsurgical instruments, as they are very sensitive to mechanical damage. Even then, damage is possible, e.g. when removing blood encrustations. The main causes for such damage are:

- metal brushes
- scouring agents
- too much exertion
- dropping or knocking

For cleaning, it is recommended to use lint-free soft cloths, plastic brushes or cleaning pistols. Drying with a pneumatic-air-pistol is particularly safe and effective and should therefore be given preference over any other drying method.

In general, dental instruments can be prepared like surgical instruments. Instructions for preparation of dental instruments, recommended for separate treatment, are given as follows:

Hand pieces and angled hand pieces as well as turbines must not be immersed. The outside is either cleaned with a cloth or sprayed with disinfectant. Only the methods specified by the manufacturers have to be applied for internal cleaning and care.

As a result of the materials used, rotating dental instruments have to be placed in special disinfecting and cleaning solution. In order to avoid corrosion, the instruments, after quick rinsing, have to be dried at once and treated with a corrosion-protecting agent suitable for sterilization. In the case of ceramic-bonded or plastic-bonded grinding tools, one must first check whether the disinfecting and cleaning agents are suitable for these instruments. Unsuitable agents may destroy the bonding materials.

Root canal instruments are sensitive to mechanical damage and, therefore, have to be prepared separately. Root canal instruments with color-anodized handles will loose their color codes when attacked by alkaline solutions.

The various components of the surgical motor line have to be externally cleaned with a lint-free cloth impregnated with disinfecting and cleaning agent. Soft brushes can also be used. When spraying the surfaces with disinfection spray, wipe the parts afterwards with a cloth. Under no circumstances should these components be immersed. Any penetrated liquid has to be removed immediately by turning the aperture upside down.

Simple tools can be prepared like surgical instruments.

Rigid endoscopes have cavities and channels which are difficult to clean. Careful preparation of these instruments requires:

- removing the seals/washers
- opening the stop cocks
- dismantling according to the manufacturer's instructions

When immersing the endoscope into the cleaning and disinfection solutions, make sure that all air bubbles escape from the cavities by moving the instrument to and fro or by holding it in a sloped position thus guaranteeing complete wetting of the surface.

Do not use metal brushes or scouring agents, but only swabs, clearing guns and brushes with natural or plastic bristles.

Use a wooden applicator with cotton wool soaked in alcohol to gently rub off any dirt on window or glass surfaces, otherwise use a neutral detergent (hand washing liquid).

Prior to preparation take off valves and caps from flexible endoscopes, thus guaranteeing thorough cleaning and flushing of the channels. For cleaning, put the endoscopes in the container filled with instrument disinfecting and cleaning agent and make sure that the surface is thoroughly wet.

Clean the channels with the brush belonging to the system followed by flushing with the cleaning solution. For this purpose some manufacturers offer a hand pump. Take particular care when cleaning the distal end (optical system, Albarran lever etc.).

Immediately after this pretreatment, abundantly rinse the instrument inside and outside with water. Then place the flexible endoscope into the container with instrument disinfecting solution so that all channels are filled. The hand, l.c. pump can now be used. Take care to disinfect the extraction nozzle. Soaking time and solution concentration have to be strictly observed according to the instructions of the manufacturer.

After chemical disinfection, thoroughly rinse all surfaces and channels leaving no residues. To avoid water spots use demineralized water. Additional sterile filtration of the water prevents undesired recontamination.

Dry the outside of the flexible endoscope with a lint-free cloth. Drying the channels should be done according to manufacturer's instructions by using a hand pump, light source and suction pump or by means of compressed air of max. 0.5 bar. Undesired recontamination is prevented when sterile and filtrated compressed air is used.

Elastic instruments with lockable cavities, such as bellows and breathing masks have to be cleaned and disinfected in closed condition thus avoiding the penetration of liquid into the cavities.

To avoid damage on diaphragms and functional parts of the breathing system, no compressed air should be used for cleaning. Machine preparation allows disinfection, cleaning, after-rinsing and drying without having the instrument handled.

3. Machine Disinfection And Cleaning

Machine preparation is usually done in the case of a dry return to CSSD. When wet removal to CSSD is the case, then either a low-foam producing disinfectant has to be used or else the instruments have to be thoroughly prewashed as foam development in the machine can considerably influence the cleaning results. This also applies for instruments having to be pretreated either in a splashing or by ultrasonic treatment because they are soiled. (e.g. owing to dried-on blood and secreta or remnants of filling material).

The temperature of the inflowing water should not exceed 45°C as higher temperatures lead to protein coagulation and cause cleaning problems.

Disinfection can either be performed chemothermally or thermally.

When using cleaning agents or combined disinfecting and cleaning agents, it is recommended to strictly follow the instructions of the manufacturer regarding induction time, concentration and temperature.

Using the correct dosage rate does not only guarantee a perfect disinfection and cleaning result but also the most careful treatment of the material. If

alkaline detergents are underdosed (false economy) there is a risk of pitting, which can be avoided at pH-values over 10.5. When acid detergents are used, corrosion may occur due to the chlorides in the water. Using demineralized water can prevent this.

With machine cleaning, special attention has to be paid to the following:

- Hinged instruments have to be opened, thus guaranteeing thorough cleaning in the joint.
- Do not overload the perforated trays so that all instruments can be well rinsed.
- A thorough internal flow has to be guaranteed with instruments having long, narrow cavities (tubing, cannulae, breathing systems). Use special inserts.
- Place instruments in such a way that they cannot damage each other.
- Place large and bulky instruments properly on the tray thus avoiding "shadows" on other instruments.
- Color-anodized aluminum instruments may lose their color and thus their coding function if normal machine preparation methods are used.

Remnants from the cleaning phase have to be totally removed in the subsequent rinsing procedures as otherwise spotting and/or discoloration may occur. Additional use of a suitable neutralizing agent improves the rinsing results.

For final rinsing, a temperature of 70-90°C has proved to be best.

Should corrosion occur on surgical instruments due to bad water quality, then the rinsing temperature should be limited to 70-75°C. Corrosion, water spots and discoloration will be avoided when using demineralized water for final rinsing. No temperature limit must then be observed.

When machine operation is done without drying, then the goods have to be removed from the machine immediately after the programme has finished. If drying is not sufficient, repeat it.

Machine preparation for microsurgical instruments is possible if the instruments are held in place in a reliable and safe manner, e.g. racks.

Dental instruments can be treated like surgical instruments for machine preparation. Pay special attention to the following:

- Probes and other delicate instruments have to be placed in racks or holding devices to be protected against damage.
- Rotating instruments like burrs, drills, milling cutters, and grinding tools are suitable for machine preparation only to a limited extent. Preference should be given to an ultrasonic bath.
- Root canal instruments should also be cleaned in an ultrasonic bath.
- Hand pieces can be prepared in a machine only if recommended by the manufacturer; special holding devices are, however, necessary. Immediately after the end of the machine programme remove any moisture using a maintenance spray recommended by the manufacturer.
- Mouth mirrors may become dull due to machine treatment, which will shorten their life span.

With the exception of simple tools and accessories, machine preparation for disinfecting and cleaning is not possible for the components of the surgical motor line.

Rigid endoscopes have to be dismantled for machine preparation according to the manufacturer's instructions.

Seals/washers have to be removed and stop cocks opened.

Machine preparation should be done only if recommended by the manufacturer for this procedure (e.g. optical equipment). In order to avoid damage, secure the parts safely and make sure that the insides of all cavities are thoroughly finished.

Flexible endoscopes can only be processed in special automatic machines. Standard disinfecting and cleaning machines are not suitable. If endoscopes are disinfected prior to machine preparation, only use a low-foam product as foam, which develops in the machine, will deteriorate the cleaning and disinfecting result.

Prior to further processing, the leak test has to be carried out according to the manufacturer's instructions. This allows for the detection of leaks and perforations in good time and avoids expensive damage caused by the penetration of fluids.

There are machines in which a leak test is incorporated either before or while the programme is activated. A leaking endoscope has to be returned to the manufacturer together with a fault description.

Standard alkaline cleaning agents may cause damage to the endoscopes, therefore, use only those products recommended as suitable by the manufacturer. Chemo-thermical processing should not exceed a temperature of 60°C.

During machine preparation, make sure the endoscope is secured and that all external surfaces and the inside of all channels are thoroughly and reliably flushed.

Final rinsing should be performed with sterile demineralized water. If, for technical reasons, this is not possible, at least water of drinking quality must be used. Subsequent to final rinsing, machine drying should be possible. Prior to storage, thoroughly dry the endoscope.

Elastic instruments with lockable cavities, such as bellows, breathing masks etc., have to be cleaned and disinfected in closed condition thus avoiding the penetration of liquid into the cavities. To avoid over stretching of the edge of the mask, remove the nipple prior to preparation, press out some air and replace the nipple.

Elastic instruments, made of PVC for example, with low temperature resistance have to be disinfected, cleaned and dried at maximum 65°C.

Care has to be taken with rubber instruments because imperfectly removed residues of cleaning agents lead to irreversible damage by subsequent drying and sterilization. The surface of the material depolymerizes and gets sticky. Latex coating dissolves under blistering.

Especially serious are residues not completely flushed out of functional parts of the breathing system. Furthermore, all parts have to be completely dry as remnants of moisture may lead to functional troubles.

Elastic instruments may not be dried above 95°C; higher temperatures considerably shorten their life span.

The manufacturers of either unit specially design functional parts of breathing systems. Preparation can, therefore, only be performed according to the manufacturer's instructions.

4. Ultrasonic Treatment

Ultrasonic treatment is particularly suitable for cleaning instruments of high-grade steel. Delicate instruments (microsurgical instruments, dental instruments) can be carefully and thoroughly cleaned by ultrasonic treatment.

Furthermore, ultrasonic treatment is a suitable method to effectively remove encrustations.

In order to achieve optimum efficiency of the ultrasonic treatment, please observe the following when preparing a bath:

- Fill the bath up to the markings.
- Add a suitable cleaning and/or disinfecting agent to the water.
- Temperature above 40°C promotes degassing and cleaning.
- No protein coagulation occurs at higher temperatures if a suitable cleaning agent is used.
- When using disinfecting and cleaning agents make sure that the concentration and temperature are correctly maintained.

Even with a properly prepared bath, faults can arise. These can be avoided by observing some principle rules:

- Instruments have to be completely covered by the cleaning solution. Non-immersed instruments will not be cleaned.
- Hinged instruments, e.g. scissors, have to be opened.
- Only trays, which do not affect the ultrasonic treatment, should be used.
- Large and bulky instruments such as lead hands or kidney trays must be placed in such a way that there are no wave shadows or inactive zones. Place such items either vertically or put them on top of the other instruments.
- An excessively dirty solution in the ultrasonic bath decreases the cleaning effect and increases the risk of corrosion. Depending on the frequency of use, the solution has to be renewed at regular intervals.
- Ultrasonic treatment times of approx. 3 minutes have proven to be efficient for cleaning at frequencies of at least 35 KHz.

After ultrasonic treatment, the instruments have to be thoroughly rinsed either manually or by machine. Rinsing has to be performed with clean water of at least drinking quality or, better still, with demineralized water in order to avoid water spots.

The instruments should then be thoroughly dried.

To avoid damage, microsurgical instruments have to be deposited on special racks.

In order to avoid destruction of surfaces and soldering seams on dental instruments, no acid cement remover should be added to the ultrasonic bath.

Hand pieces and turbines are not suitable for ultrasonic cleaning.

As a result of the material used, rotating dental instruments have to be treated with special disinfecting and cleaning agents. Prior to ultrasonic treatment place them on special holding devices to avoid contact damage between the instruments (e.g. by sharp cutting edges, diamond grain). After a quick rinsing under running water followed by immediate drying, rotating dental instruments have to be treated with a corrosion-protecting agent suitable for sterilization.

Mouth mirrors can be damaged by ultrasonic treatment.

Under no circumstances use ultrasonic treatment for components of the surgical motor line, with the exception of simple tools and accessories.

Ultrasonic treatment is only allowed for those parts of rigid endoscopes which are suitable for this procedure according to the manufacturer's instructions (e.g. no optical systems).

Flexible endoscopes are not to be treated in an ultrasonic bath. Accessories, such as valves, caps, bite rings, and forceps are suitable for ultrasonic treatment.

Elastic instruments are not suitable for ultrasonic treatment, as ultrasonic waves have no effect on elastic surfaces.
Functional parts of the breathing system can also not be prepared in an ultrasonic bath.

5. Care And Maintenance

Instruments with joints or ratchets have to be treated with suitable lubricating agent during the cleaning process.
These lubricating agents prevent the friction of metal and preserve smooth function of the instrument thus avoiding corrosion by friction. Furthermore, constant use of such agents prevents "sticking" of the hinged parts.
The care agents can either be applied manually or during the final rinsing in the machine.
In any case, it is indispensable that threads, joints etc. difficult to access are directly treated with each preparation.
Dental instruments have to be cared for like surgical instruments with the exception of the following:

- Hand pieces, angular hand pieces as well as turbines have a very complex internal design. Therefore, they have to be treated with special agents in accordance with the instructions of the manufacturer.
- Immediately after drying, treat all rotating dental instruments (drills, burrs) with a corrosion protection agent, suitable for sterilization in hot air or steam.

Motor lines have to be lubricated and maintained with agents recommended by the manufacturer. Hand pieces, which are not watertight, have to be sprayed with special care agents for inside cleaning and lubrication.
Apply a few drops of special oil into the supply channel of pneumatic surgical motors. To distribute the oil inside, run the motor for a few seconds with compressed air. Proper lubrication and maintenance of the motor line is of great importance, therefore, the manufacturers instructions must be followed.
Rigid endoscopes must not be lubricated.
However, joints and non maintenance-free stopcocks may have to be treated with special oil or special grease according to the manufacturer's instructions.
The only necessary maintenance on flexible endoscopes is to treat the valves with silicon oil before inserting them into the valve housing. Do not spray them with care agents, as the propellant gases will damage the instruments.
Only silicon oils and grease-free gels should be used as lubricants. Agents containing Vaseline or paraffin cause swelling or softening of rubber parts.
Refrain from treating elastic instruments and breathing systems with lubricants prior to sterilization. Special care and maintenance measures are prescribed by the manufacturer, should the need arise.
Elastic instruments of silicon rubber may not be treated with silicon because of swelling which makes them inoperable. Under no circumstances use paraffin agents for rubber and latex instruments; this prevents them from swelling up.

6. Inspection

After each cleaning, the instruments have to be macroscopically clean, i.e. free of visible protein remnants and other contamination.
Prior to functional inspection, surgical instruments with movable parts should be cooled down thus avoiding metal friction leading to corrosion. Before carrying out functional inspection, oil

any instruments with joints, ratchets or threads.

Instruments with non-traumatic toothing have to be specially inspected, and, if necessary, manually reclean the non-traumatic toothing.

Worn out or damaged instruments should be removed for repair or replacement. Corroded instruments should be discarded immediately as these can cause contact corrosion even on a perfect surgical instrument.

Stains on surgical instruments are due to improper preparation. Causes of such stains or spots can be:

- Insufficient mechanical or manual cleaning.
- Unsuitable cleaning, disinfecting and care agents.
- Failure to observe the dosage instructions for cleaning, disinfecting or care agents.
- Remnants of cleaning and disinfecting agents-insufficient rinsing.
- Poor water quality.
- Residues in the sterilizing steam, when steam quality is not in accordance with recommendations.
- Remnants of medications, marking pens or chemo-indicators.
- Procedural faults e.g. not cleaning brand-new surgical instruments prior to sterilization.

These and other causes for spots on surgical instruments show the complexity and difficulty of the problems dealt with here. To facilitate tracing and finding the cause for such stains, it is recommended to cooperate with competent manufacturers. By making use of the company's service, you will not only take advantage of their practical experience but their well-equipped laboratories as well.

To avoid permanent damage, instruments with remnants on the surface have to undergo a special treatment. The method of treatment is adapted to the cause of the stains. In order to avoid damage and subsequent corrosion due to metal friction, under no circumstances use metal brushes or metal sponges to remove stains.

Each surgical instrument is designed for a specific purpose. Inspection has to be carried out to ensure that they still function, as they should. If in any doubt, a reliable manufacturer can advise you on suitable inspection methods.

Especially fine and delicate instruments are inspected under the magnifying glass. In order to avoid damage during transportation, place the instruments in specially designed racks or use special holding devices to prevent them from slipping.

Faultless surgical instruments should not be packed together with instruments having damaged surfaces. Older instruments with chipped chromium and/or nickel coating may cause discoloration or corrosion on high-grade surgical instruments. It is, therefore, recommended to discard such instruments or pack them separately.

Handles, cables and cables for neutral electrodes for HF-surgery have to be checked for faultless function.

(Caution: defective contact). It is compulsory to sort out defective parts.

Prior to sterilization, the surgical motor line with accessories should undergo a functional inspection according to the manufacturer's instructions.

Units operating with compressed air should be checked for leaks and be given a functional inspection. Any leakage will be audible or can be found by immersing the hose into water.

For checking the exhaust channel, additionally connect the pneumatic surgical motor to the compressed-air hose. With the motor running, leaks can best be detected in water.

Simple tools are inspected as general surgical instruments. In order to avoid damage during transportation, store the tools in special racks or place them in suitable holding devices to prevent them from slipping.

The leak test for tubing sets for cooling liquid can be carried out by means of a clamp and a large syringe filled with water. Fill the tubing with water; close one end with the clamp, and insert and empty the filled syringe in to the other end.

In case rigid endoscopes are used, check the additional instruments for HF-surgery for absolutely perfect insulation. Exchange damaged parts.

Surfaces of electrodes/loops must be free from encrustations, which can be removed with fine abrasive powder. Take care that neither insulation nor clips get damaged or deformed.

To avoid damage to optical systems, clean them carefully with a swab moistened with alcohol. If this does not remove the clouding, return the part to the manufacturer for inspection. Damage can be avoided by using wooden or plastic applicator, metal is not suitable.

Optical wave-guides and fibre-optic cables have to be checked for optical fibre breaks. To find this out, take one end of the fibre optic cable, hold it against the light and then look into the other end. Little black spots indicate breaks in the fibres. A large number of breaks reduce the light output. Such fibreoptics as well as endoscopes with surface damage and surface deformation should be sent for repair.

Normally, clouding of the optical system on flexible endoscopes can be removed by using a wooden applicator (not metal) soaked in alcohol. If this does not help, return this instrument to the manufacturer for inspection.

Optical fibre breaks in the optical wave-guide can be seen by holding the proximal end against the light and looking into the distal end. Quite a number of breaks considerably reduce the light output. Such damaged instruments have to be returned to the manufacturer.

Endoscopes with visible external damage (e.g. deformation in the insertion part or on the supply tube, over stretched angled rubber) have to be returned to the manufacturer.

Flexible endoscopes are best dried whilst suspended and should be stored unfolded. Locks and feed-reels should be loosened. The transportation case should not be used for storage.

Prior to every use, check all functions of the endoscope. Use only silicon oils or greaseless gels as lubricants. Under no circumstances should Vaseline or lubricants containing paraffin be used as these cause softening or swelling.

Breathing systems have to be inspected according to the manufacturer's instructions.

Elastic instruments have to be inspected according to their function and range of use. The most important inspections are:

- Bellows have to be undamaged and airtight.
- Filling system of the bellows must not show any leakage.
- Lumina of catheters and probes have to be free.
- Connections have to meet functional safety.
- There should be no changes of design, e.g. radius of curvature of tracheal tubes.

Elastic instruments with faults or damage have to be replaced. Frequent problems are:

- Dissolvation (blister formation)
- Cracked surface
- Sticky surface

- Hardenings
- Porous surface
- Discoloration

To prevent premature failure, take care that elastic instruments are stored in a dry place without being kinked or over-stretched.

7. STERILIZATION

General

Sterilization conditions as well as units have to be in conformity with valid quality standards.
Follow the sterilization instructions of the manufacturer. Sterilizing accessories as well as sterilizing packings have to meet the requirements of both the instruments as well as the sterilizing method used.

7.1 Autoclaving

Normally, autoclaving is performed with saturated water steam at 134°C. In special cases a temperature of 121°C can be used for a longer time.
Sterilization procedure has to be standardized suitably for the goods to be sterilized. Sterilizing packings have to meet the valid standards with regard to quality and application of the packings and have also to be applicable to the procedure selected.
Steam used for sterilization has to be free from any contamination and should neither impede the process nor do damage to the sterilizer or the goods to be sterilized. In order to guarantee this, meet the recommendations of pr EN ISO 9001:1994 285 regarding the quality of the water in the tank as well as the condensate, otherwise rust particles from the conducting system may cause corrosion or a too high content of silicic acid may leas to discoloration of the instruments.
Due to heating and cooling down during the sterilization process, a surgical instrument with a closed ratchet may suffer from tension stress, which causes stress cracking in joints or deterioration of the clamping force. Therefore, such instruments have to be sterilized either in open condition or closed on the first ratchet only.
The loading weight of perforated trays filled with instruments should not exceed 10 kg.
After sterilization, instruments have to be stored dry until used again. Instruments as well as the inner covering of sterilized goods have to be absolutely dry after having cooled down to room temperature.
Excessive condensate production during sterilization is avoided by observation of the recommended maximum weight for loaded perforated trays. Wrapping the perforated trays into a cloth within the container or external paper packing facilitates drying.
If heavy sets are unavoidable, the instruments should be distributed among several perforated trays. In addition, special measures may be necessary for drying.
In general, dental instruments can be autoclaved like surgical instruments. When separate treatment for dental instruments is necessary, obey to the following instructions:

- Rotating dental instruments (e.g. burrs or milling cutters) can be autoclaved.
- Hand piece should, whenever possible, be autoclaved at 134°C, due to the shorter induction time.
- Check whether turbines are suitable for autoclaving with the manufacturer.
- For mouth mirrors, refer to manufacturer's instructions.

All components of the surgical motor line, meant for sterile application, can be autoclaved at 134°C. Refer to the

manufacturer's instructions. Special instructions of the manufacturer have to be observed for storage during sterilization.

Hoses for compressed air have to be protected against pressing during sterilization.

Apart from the optical system with rigid endoscopes, all endoscopic parts (insert, trocar, trocar sheath, shaft, mandrel) have to be separated from each other and can then be sterilized like surgical instruments. Sterilizing instructions from the manufacturer have to be observed for optical systems. Optical systems suitable for autoclaving should be processed at 134°C instead of at 121°C due to the shorter thermal stressing.

Flexible endoscopes are not autoclavable due to restricted temperature compatibility. If necessary, use gas sterilization. Instruments used for endoscopy, such as clamps, catheters etc. may be autoclaved.

Elastic instruments with and without bellows made of silicon and natural latex are suitable for autoclaving. Due to the shorter thermal stress, preference is given to a processing at 134°C. Items of thermo-plastic materials (plastic) may only be autoclaved if recommended by the manufacturer.

When elastic instruments are autoclaved, take care that the cavities, e.g. edge of mask, bellows, are open in order to avoid damage due to changes in pressure.

Prior to sterilization, cavities closed with a valve (e.g. bellow catheters) have to be sucked free of air and water by means of a syringe.

Functional parts of breathing systems can be autoclaved at max. 134°C. Cavities must not be closed in order to avoid damage to the valves.

7.2 Hot-air sterilization

When surgical instruments are hot air sterilized, please take care to load and operate the sterilizers properly. To ensure safe sterilization, the temperature should not be below 180°C but should also not exceed 200°C as this may cause structural changes leading to irreversible damage, especially as far as microsurgical instruments are concerned. Instruments with parts of rubber, plastic or textile as well as plastic coated instruments and handles for electrodes are not suitable for hot-air sterilization.

The general use of lubricating agents should be omitted prior to hot-air sterilization. Only oil the joints and ratchets of surgical instruments.

Dental instruments can generally be sterilized like surgical instruments. When separate treatment for dental instruments is necessary, obey the following instructions:

- Temperature should not exceed 180°C when sterilizing hand pieces.
- Turbines are not suitable for hot-air sterilization.
- Burrs and milling cutters must not be sterilized at a temperature exceeding 180°C in order to avoid softening.
- The sterilizing of mouth mirrors has to be carried out in accordance with the manufacturer's instructions.

Components of the motor line are only partly suitable for hot-air sterilization, due to the various materials used.

Rigid endoscopes are not suitable for hot-air sterilization.

Flexible endoscopes are not suitable for hot-air sterilization.

Elastic instruments are not suitable for hot-air sterilization. Breathing systems are not suitable for hot-air sterilization.

7.3 Gas sterilization

Gas sterilization should only be used when no other method is suitable.

Components of motor line should only be gas sterilized when explicitly recommended by the manufacturer.

Optical systems of rigid endoscopes may be gas sterilized, however, follow the instructions of the manufacturer.

Flexible endoscopes can be gas sterilized at a temperature limit of 60°C. Use higher temperatures only when indicated by the manufacturer.

For gas sterilization, the flexible endoscope is packed in a transparent sterilizing hose allowing a curvature diameter of at least 30 cm. It is very important to make sure that the venting cap is adapted to the supply connector, as otherwise irreversible damage will occur.

To ensure protection against mechanical damage, the sealed flexible endoscope is put into a wire basket belonging to the gas sterilizer. Again, pay attention that the curvature diameter is not less than 30 cm.

Goods sterilized with ethylene oxide require sufficient airing times before being used again. Depending on the goods sterilized and on available airing conditions, such airing times can differ considerably. Only the manufacturer of endoscopes can give reliable airing times. After airing, flexible endoscope should be stored in an extended position.

Elastic instruments of thermolabile plastic are not autoclavable but can be gas sterilized if the manufacturer gives instructions about a suitable procedure.

Elastic instruments of rubber and functional parts of breathing systems do not have to be gas sterilized; use autoclaving.

8. Treatment Of Brand New Instruments

Packings of brand-new instruments have to be removed and instruments have to be stored in dry rooms, open to air. Temperature fluctuations may otherwise lead to condensation within the plastic packing and thus corrosion.

Under no circumstances store instruments in cupboards or rooms where chemicals are kept which can produce corrosive vapours.

Prior to first use, brand-new instruments have to be prepared. First remove any protective caps or foils. Cleaning, rinsing, lubrication, inspection and sterilization have to be carried out according to the procedures previously described.

Prior to the first preparation, microsurgical instruments have to be placed in racks or holding devices to avoid damage.

Elastic instruments have to be kept in their original packing and stored in a dry, cool and dark place. When ordering supply, please keep in mind that in addition to wear through use, elastic instruments are prone to aging even when in storage.

Functional parts of the breathing system frequently contain valves or membranes, which can get sticky when stored for a longer period. Such valves or membranes have to be tested and operated before being put to use.

9. Special Information

9.1 By following these instructions properly, there is no difference in the preparation of instruments with a mirror finish or matte surfaces.

9.2 These instructions do not refer to disposable items.

9.3 Instruments and cables with optical wave-guides can generally be prepared like surgical instruments, if the manufacturers have not given other instructions.

Only hot-air sterilization and ultrasonic baths cannot be used.
Fibre-optic cables should not be bent, nor coiled too tightly.

9.4 Cables and handles for HF-surgery can be machine prepared and are autoclavable.

For all other preparation processes, refer to the instructions of the manufacturer.

10. Water For Preparation

Instruments must have certain characteristics in order to fulfil their function (e.g. cutting ability of scissors, clamping force of clamps and forceps). Only a limited number of steels meet these requirements. Unfavorable water composition can, therefore, have a detrimental effect on such steels. Consequently, the quality of water must be taken into account when planning the sanitary installations.

Ordinary water contains dissolved salts. The amount of salts contained varies depending on the water purification process. Evaporation of water leaves remnants of salty encrustations (lime). Of all water components, chlorides have to be regarded as the most potentially damaging because in high concentrations they cause pitting on instruments.

The relationships between chloride content in the water and pitting are not predictable in some cases.

In general, the danger of chloride induced pitting rises with:

- Increasing chloride content
- Increasing temperature
- Decreasing pH-value
- Longer induction time
- Rougher instrument surface
- Insufficient drying.

Experience shows that with a chloride content up to approx. 120 mg/l (corresponding to 200 mg/l NaCl = sodium chloride) the possibility of pitting is low but rises rapidly with increasing chloride content.

Low concentration of other components can cause brown, blue, and grey-black or rainbow colored discolorations. Such discoloration can be caused be contact with the elements iron, copper, manganese, magnesium and silicon in the water. Generally, there is no corrosion. By immersing or rubbing the instruments with suitable products containing acid (follow the instructions of the manufacturer) such discoloration can be removed to a great extent. In addition to the natural water components, sometimes there are rust particles in the water. Almost always, such rust comes from corroded piping systems. When preparing the instruments, such rust particles deposit on the goods and cause rust spots (extraneous rust) followed by corrosion.

Make it a basic rule to use demineralized water for final rinsing.

Even when using an ion exchanger for demineralization, tarnishing can occur due to penetration of silicic acid. The remedy is in-time regeneration of the exchanger - consult an expert.

11. Materials

When producing surgical, microsurgical and dental instruments, the manufacturer will use the materials most suitable for the purpose for which the instrument is intended.

In most cases, the demands for high elasticity and toughness, good cutting ability and high wear resistance together with best possible corrosion resistance can only be answered by using metal materials for surgical instruments. Therefore, first of all, stainless and hardenable chromium steels with a chromium content of

approx. 13% are used. Instrument characteristics, such as a smooth and homogeneous surface, a matte or mirror finish, and a hardened condition can be achieved with steels. The user has to observe, however, that these instrument steels, listed in national (DIN) and international (ISO) Standards, are generally resistant to chemical and thermal stress as occurring in doctor's practices and hospitals, but are, on the other hand, very sensitive to stress corrosion and chloride induced pitting.

Apart from the hardenable stainless chromium steels, non-hardenable chromium steels with modified chromium content and rust and acid resistant chromium-nickel steels are used. The use of the latter steels is limited to certain instrument types due to restricted mechanical properties.

For the manufacture of rigid and flexible endoscopes of all kinds, chromium steels are hardly taken into consideration. Due to the application technique and design of the endoscopes, the greatest variety of materials is used. Here are some of the most important ones:

- Rust and acid resistant chromium-nickel steels.
- Surface treated non-ferrous heavy metal alloy e.g. brass, chromium-nickel plated.
- Light metals (e.g. anodized aluminum).
- Non-corrosion resistant steels, e.g. for lacquered modules and single parts.
- Glass for optical systems.
- Ceramic.
- Cement and adhesives.
- Plastic and rubber.

The combination of these heterogeneous materials is, with regard to the preparation of the units, a weakness in the chain of materials. It may, therefore, be possible that special processing, deviating from the ordinary preparation processes, may become necessary. When in doubt, ask the manufacturer should he not already given recommendations for use.

Elastic instruments and breathing systems also demand a wide variety of materials, similar to those used for endoscopes. i.e. rubber, latex and silicon.

The full scale of materials dealt with in this brochure is used for the motor line as far as design, structure and manufacturing is concerned. Stainless, hardenable chromium steels are used for burrs, drills, milling cutters, saw blades and gearing parts as well as sterilizable plastic material for handles, switches, gearing parts or cables and hoses.

Special preparation methods may be necessary for enameled housing of the unalloyed steel sheet, lacquered color codes for identification of the gearing on hand pieces or anodized housings of aluminum for hand pieces and angular hand pieces. Heavily used flexible cables, bearings and gearing parts of stainless, but also of non-stainless heat-treatable steels as well as bronze materials require special preparation and lubrication methods.

12. Surface Changes, Corrosion And Aging

Surface changes are visible appearances. Normally, this refers to all kinds of instruments and units, independent of the material. In particular, this refers to removable residues such as adhering or already encrusted remnants from operations or other soilings. Through cleaning using special basic cleaning agents, such surface changes can be completely removed without doing any harm to the instruments.

Quite often, yellow-brown to dark brown blister-like spots show on sterilized instruments and units made of metal and are mistaken as rust. In most cases, such residue can contain high degrees of chlorides, which then lead to chloride induced pitting on parts made of stainless steel if the spots are not removed immediately. Such residues are usually found on those places with difficult access for cleaning.

Annealing colors, black tints or water spots appear mostly on metallic instruments and units and hardly ever on rubber or plastic products.

In general, discolorations do not show clearly defined edges. Flowing color shadings or deep and uniform staining (black colorings) can appear. Discoloration does not permanently damage or destroy the instruments or units. Causes can either be the bad quality of water used for cleaning or autoclaving as well as inadequate machine cleaning and installations for steam supply. The only remedy is to check the technical equipment in the house installation, in cooperation with the manufacturer of cleaning, sterilization and steam supply plants and also together with the manufacturer of disinfectants or cleaning agents.

Water spots are similar in appearance. However, normally they show sharply defined edges and are caused by too high a concentration of minerals e.g. lime or organic substances in rinsing water or sterilization steam.

The remedy is to use demineralized water for final rinsing and pure steam.

Overloaded sterilizing plants may cause increased condensation and consequently increased stains during sterilization – therefore avoid overloading.

The term *corrosion* refers to metallic material only. Corrosion is specific to materials and occurs on various metals in different appearances. Almost always the corrosion leads to permanent damage or even destruction of instruments and units.

Any kind of corrosion on surgical instruments and units can only occur due to inductions of water, aqueous solution of the most important kinds of corrosion and their effect, in the sequence of their frequency of appearance.

Pitting corrosion refers only to metallic materials. Unfortunately, pitting can also appear on stainless steels of which not only most surgical instruments are made, but also endoscopes, (although fewer in number), surgical motor line and parts of breathing systems. With all types of steel, pitting is mainly caused by active chlorides (chloride induced pitting). Other halide ions (iodides, bromides) have the same effect. Pitting can also damage non-ferrous metals such as copper and aluminum alloys, however, other electro-chemical causes may also be the reason.

Pitting means that holes have developed on the surface of the instruments. These holes indicate rust and, with continuous corrosion, get rapidly bigger and destroy the instrument within a short time.

Pitting can only be avoided if instruments that have been in contact with chlorides or other halide ions are cleaned immediately after use. Please note that operation debris also contains chlorides, which lead to pitting should these remnants stay long enough on the instruments.

Attention also has to be paid to the quality of water used for cleaning and disinfection, especially with regard to its chloride content.

Stress corrosion cracking normally occurs only in steels used for surgical instruments; it can have considerable

effects on the life span of the instruments.
The causes of this type of corrosion can lie either in the manufacturing process or in incorrect handling.
In order to avoid damage, it is absolutely necessary that during the complete cleaning phase, all instruments be kept in open condition.
In order to avoid damage such as stress cracks in the joint and a reduction of clamping force, when sterilizing such instruments, only close the first ratchet. This prevents stress forces from occurring while heating and cooling during the sterilizing process.
Even tiny quantities of chlorides in the water may favor the forming of stress corrosion cracking.
Fretting and crevice corrosion have almost similar causes. Both types of corrosion occur in narrow joints due to chemical or mechanical destruction of the natural passive coating of the high quality steel. In addition, due to lack of sufficient lubrication, metallic abrasion occurs in joint crevices and hinders smooth action of the instrument. In both cases, and together with humidity, rust blisters occur in the crevices.
Contact corrosion can occasionally be observed when surgical instruments are machine cleaned. Metallic contact of instruments and unfavorable cleaning and rinsing conditions, e.g. tap water containing chlorides, can cause rust.
Particularly severe contact corrosion occurs if stainless steel instruments get in contact with non-stainless goods, such as needles, cutters etc. Chromium-plated instruments with chipped surfaces also cause contact corrosion.
With surface corrosion, the total surface of a metal part is relatively uniformly attacked by chemical or other electro-chemical influences. The surface can show parts, which differ in color to undamaged surfaces. This corrosion takes the form of rust where steels are concerned.
Surface corrosion hardly ever occurs with instruments made of stainless steel.

Instruments, trays and containers of anodized aluminum ask for a preparation method suitable for the material. Acid or alkaline solutions may cause laminar corrosion, which, especially on colored parts, caused “bleaching”.
Instruments and units of stainless steel of non-ferrous metal, protected by galvanically applied coatings, show surface corrosion only with damaged protective coatings.

Any kind of corrosion leads to rust on steels. Rust particles are transferred from one instrument to another during disinfection, cleaning or sterilizing, so this *transferred rust* causes *resultant corrosion* on the second instrument. If corroding instruments are not separated, further preparation processes promote rust formation on other instruments.
Sterilizing steam from rusty steam supply pipes may transport rust particles into the sterilizer. This extraneous rust deposits itself on the inside of the sterilizing chamber, on the packings, on instrument surfaces. This *extraneous rust* also leads to *resultant corrosion* on instruments.

Aging mainly refers to rubber and latex materials used for flexible instruments, such as parts of endoscopes and breathing systems. Aging is a slow going natural process occurring also during storing. The aging process is accelerated by the induction of a dry heat with temperatures above 80°C, by stretching and overstretching when storing as well as by the action of light (e.g. sunlight,

UV beams). Aging is visible on rubber by discoloration (brownish) or brittleness (cracks on the surface). Plastic also ages; it gets hard and becomes yellow. However, silicon cautchouc, also called silicon elastomer, does not age.

Another result of aging on rubber, latex and plastic is the so-called swelling, which is caused by the penetration of liquid or gases to the surface.

Swelling can be reversible and occurs only temporarily by the induction of volatile solutions or propellant gases of sprays. This also applies if rubber and certain plastic get into contact with ether gases such as halothane. Irreversible swelling, however, occurs by contact with non-volatile oils (paraffin), Vaseline and unsuitable disinfectants (e.g. phenol derivatives). Silicon cautchouc reacts reversibly on propellant gases of sprays and ether gases; irreversibly on silicon oils and solvents.

Typical signs of swelling are soft sticky surfaces as well as damage to thin walled instrument parts.

13. BRIEF INFORMATION

- Brand-new instruments have to be cleaned prior to the first sterilization.
- Instructions for use have to be strictly observed.
- Strictly adhere to dosage, induction time and temperature for disinfecting and cleaning.
- Used instruments have to be treated as soon as possible.
- Open joints on instruments prior to preparation.
- Use proper accessories for cleaning.
- Do not overload washing machines and ultrasound devices. Avoid rinsing shadows as well as wave shadows.
- Never use metal brushes or metal sponges for manual cleaning.
- Rinse thoroughly and carefully after cleaning. If possible, use demineralized water.
- Dry sufficiently after rinsing.
- Worn, corroded, deformed, porous or otherwise damaged instruments have to be sorted out.

MATERIALS AND THEIR USES

"Stainless steel" is the material employed for the great majority of instruments but other materials are employed when specially suited to particular requirements. Non-ferrous materials are employed for the manufacture of those items for which their mechanical properties render them particularly appropriate; these may be plated to prevent tarnishing. Copper is used for its extreme malleability, Silver on account of its ease of fabrication and tissue tolerance and Brass is commonly used for aural specula, bronchoscopes, laryngoscopes, etc. Plastics materials now find a number of applications and the use of Tufnal for orthopedic and other instrument handles has improved the balance and feel of a wide range of instruments.

STAINLESS STEEL

The term stainless steel is applied to a very large family of ferrous alloys with varying chemical and mechanical properties. Those used for instruments fall into two categories, Martensitic steels which may be thermally hardened and tempered and Austenitic steels which may be "work hardened".

Martensitic steels are essentially alloys of iron with chromium and carbon together with trace elements, sulphur, phosphorus, etc. and the range over which they may be hardened depends very largely on the carbon level. The alloy containing 13% chromium and

carbon in the range 0.15 to 0.2% is used for the vast majority of hemostats, towel clips, retractors, etc. and similar alloys with carbon in the range 0.22 to 0.35% are employed for edge instruments, scissors, chisels, knives, etc. austenitic steels i.e. those containing chromium and nickel in relatively high proportions, are only employed for retractor blades, nuts, screws, pins, etc.

IMPLANT MATERIALS

The four materials currently employed for implant manufacture, stainless steel, titanium and its alloys, chrome cobalt molybdenum alloy and high-density polyethylene; meet British, U.S and International Standards.

(BS3531, ASTM F55, F75 and ISO 5832)

STAINLESS STEEL

Very high purity Austenitic materials are used for the production of bone plates, compression plates, bone screws, hip nail, intramedullary nails, etc.

COBALLOY

Chrome-Cobalt-Molybdenum Alloy, meeting accepted Standards, is employed principally in the manufacture of total hip replacement components and prostheses.

TITANIUM ALLOY

The Titanium-Aluminum-Vanadium Alloy is now accepted as having a superior combination of mechanical properties and bio-compatibility compared to those of other currently employed implant materials. This alloy is employed for the manufacture of all weight bearing implants, total hip joints, replacement prosthesis, etc.

TITANIUM (Commercially Pure)

Commercially Pure Titanium is available as a series of oxygen alloys with a range of malleability. Grade 5 has the greatest malleability, Grade 1 the lowest. Grade 5 is employed for the manufacture of mandibular implants requiring contouring during operation. Grade 1 is employed for small bone plates.

ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE

The Ultra High Molecular Weight Polyethylene used for implants is specially made for this application and is primarily used for the acetabular components of total hip joints.

IMPLANT MATERIALS BS3531 CHEMICAL COMPOSITION

Austenitic Stainless Steel

Element	Composition A %	Composition B %
Carbon	0.08 max.	0.02 max.
Silicon	1.0 max.	1.0 max.
Manganese	2.0 max.	2.0 max.
Nickel	10.0 – 14.0	10.0 – 14.0
Chromium	16.0 – 19.0	16.0 – 19.0
Molybdenum	2.0 – 3.5	2.0 – 3.5
Sulphur	0.01 max.	0.01 max.
Phosphorus	0.025 max.	0.025 max.
Copper	0.25 max.	0.25 max.
Iron	Balance	Balance

Chrome-Cobalt-Molybdenum Alloy

Element	%
Chromium	26.5 – 30.0
Molybdenum	4.5 – 7.0
Iron	1.0 max.
Carbon	0.35 max.
Nickel	2.5 max.
Silicon	1.0 max.
Manganese	1.0 max.
Aluminum	0.14 max.
Titanium	0.14 max.
Cobalt	Balance

Titanium and Titanium Alloy

Element	Grades T1, T2, T3, T4, T5 %	Grade TA1 %
Oxygen	0.50 max.	0.20 max.
Iron	0.20 max.	0.30 max.
Aluminum	-	5.5 – 6.75
Vanadium	-	3.5 – 4.5
Titanium	Balance	Balance
Carbon	Raw materials used for the production of an ingot shall contain not more than 0.08 carbon.	
Hydrogen	Plate, sheet, strip, bar, and section for machining, wire	0.0125 max. 0.010 max.

	Forging stock Forgings	0.015 max.

ALWAYS:

- Check all instructions for use and sterilization of new instruments. Unless otherwise directed, they should be cleaned and lubricated before being put into service.
- Ensure instruments are only used for the purpose for which they were designed.
- Handle all instruments gently. Never overstrain, drop or misuse them.
- Check all instruments for damage after use.
- Clean and decontaminate all instruments in cold or warm water as soon as possible after use. Failure to do so may result in the instrument becoming stained and the joints stiff.
- Give special attention to microsurgical instruments. Their fine tips can easily be damaged by contact with other instruments or the sides of the case in which they should be kept.
- Ensure that the detergent is at recommended strength if ultrasonic or cleaning machines are used.
- Lubricate after cleaning with a proprietary water-soluble instrument lubricant.
- Ensure all instruments are thoroughly dried before being stored.
- Pack instruments carefully with the heavier ones lying on a piece of cloth or towel at the bottom.
- Store and sterilize bow-handled instruments on a special holder, racks and ratchets left open.
- Check the hardness of water used in the autoclave. Too hard water will leave a deposit on the instruments.
- Check that a water softener, if used, is at the recommended level. Too much may cause discoloration or pitting.

NEVER:

- Misuse surgical instruments.
- Overstrain joints or racks.
- Leave soiled instruments to dry. If it is impossible to clean them immediately after use, soak them in cold water for as short a period as possible.
- Use abrasives on instruments, as this will spoil the surface finish. This may later cause discoloration, rusting or pitting.
- “Impact” mark or “vibro-etch” instruments. This can lead to failure of the instrument at a later date.
- Handle micro instruments by their tips. These should be cleaned by trained personnel only who will ensure the delicate working ends are adequately protected during storage or sterilization.
- Use forceps to handle endoscopic instruments. This will help to avoid them being scratched, dented or dropped.
- Leave instruments soaking longer than necessary in chemical sterilizing solutions. After they have been sterilized they should be washed thoroughly in warm water to remove all traces of the chemicals.
- Store damp instruments. They must be thoroughly dried first.