STANDARD OPERATING PROCEDURE MANUAL FOR

MAINTENANCE OF MICROSURGICAL INSTRUMENTS

REPAIR OF MICROSURGICAL INSTRUMENTS

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Foreword

This Standard Operating Procedure manual for repair and maintenanceof microsurgical instruments was writen as an aditional comprehensive manual next to the existing video on this subject (produced by the Jan Worst Research Group and Danny Haddad).

This manual was writen using experience gained working with Prof. Dr. Jan Worst and Nus Aponno from 'The Jan Worst Research Group' (JWRG) in the Netherlands. Practical experience was obtained during several 'Appropriate Technology in Ophthalmology' projects in Afrika, Asia and the Pacific. During these projects the techniques learnt with the JWRG were adapted to work under all circumstances and settings.

The authors are fully aware of the existence of other techniques. However the techniques discribed in this 'Standard Operating Procedures' (SOP) were found to be the easiest to learn and usable under most conditions. For some of the techniques some special tools are required, which might not be available in all countries. A list of addresses where some of the equipment can be purchased is added at the back of the SOP.

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Maintenance of instruments

1. Introduction

Instruments can be used for a long time, if they are maintained well. In order to keep instruments in a good shape, good cleaning, storage, and sterilisation are necessary. All persons handling microsurgical instruments should be aware of the right way of handling these delicate and fragile instruments.

To eliminate the chance of damage when dropping an instrument, make sure that, when handling microsurgical instruments, there is always a table underneath it. Never keep instruments above the floor, since this will give the risk of dropping instruments on the floor from a height, which will damage them.

2. Cleaning Instruments

2.1 Theoretical background

1. Importance of cleaning
It is very important to note that sterilisation of instruments is not the same as cleaning instruments! Before sterilisation, instruments should be cleaned very thoroughly. This should be done as soon as possible after the surgery. Rest material on instruments, which dry up, will be difficult to clean. Blood cloths will dry up into a hard crust and will be difficult to remove later on. If these hard crusts are not removed, they will impede sterilisation. Cannulas have to be flushed with clean water immediately after use, to prevent blockage from rest tissue.

2. Precautions
Most of the hospitals in western countries, have washing machines to clean the surgical instruments. If cleaning of instruments is done manually, precautions have to be taken to reduce the risk of contamination through dirty instruments. When sharp instruments are cleaned and there is a risk of puncturing the skin, the instruments should be disinfected first (e.g. with a liquid disinfectant). Always wear gloves when cleaning instruments that are contaminated.

3. Prevention of damage during cleaning
In order not to damage the instrument during the cleaning process, use only mild neutral soaps such as those used for handwashing dishes. Dissolve some soap to make a water and soap solution. Never use powder, which is not dissolved into a solution. Do not use any soap with bleach or an abrasive in it (soaps used for cleaning toilets and floors). These might damage the coating of the instruments. The instrument should be cleaned with a soft sponge or a piece of gauze. Do not use hard instruments, like metal brushes, etc. These might give scratches on instruments, which will be places for rust formation.
Do not scrub the instruments while cleaning, but clean them lightly (but thoroughly!).

4. Cleaning the joint of an instrument
The inner part of the joint should be cleaned very well. This is usually the place were most of the blood and tissue rest will stick. Open the lock at the back of the instrument, to access the joint completely. To open the lock, rotate the male part, so it can slip out of the female part (see 2.2.5). Do not use force to open the lock, since that might damage it.

5. Dry instruments after cleaning
After cleaning, the instruments should be rinsed with clean water to remove the soap. Dry the instruments before storage.
Do not leave instruments in water or disinfectant for too long. Never leave instruments overnight or over a weekend in a solution (like saline)! This will lead to corrosion.

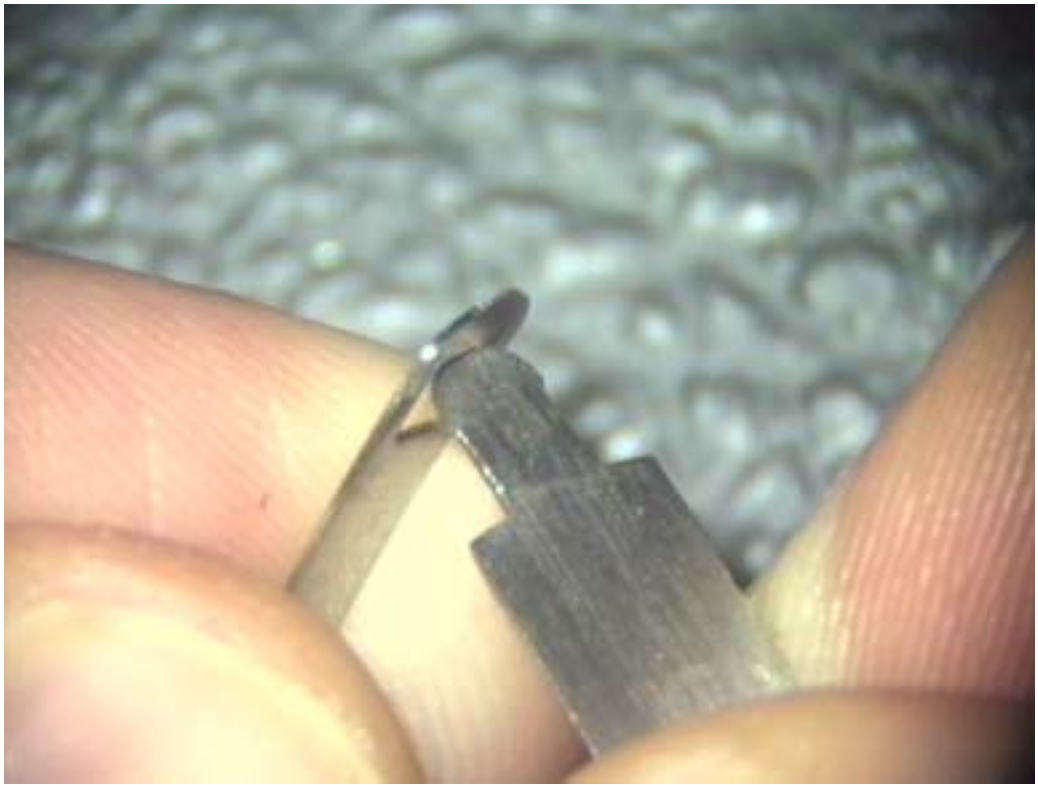
6. Clean instruments before first use
New instruments and instruments, which have been repaired, should be cleaned thoroughly before sterilisation. Dirt from manufacturing, transport or repair may be on the instrument and have to be cleaned before use. These foreign materials can lead to inflammation!

2.2 Cleaning step by step

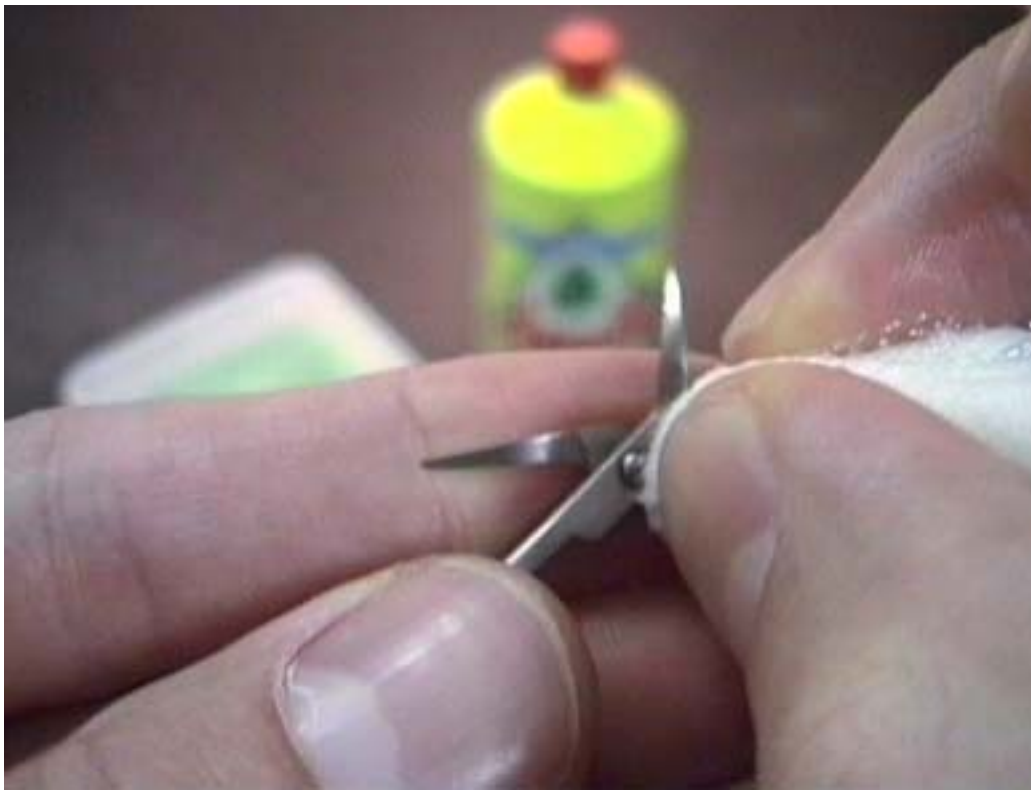
1. Make a water and soap solution in a mild concentration.

2. Use a piece of gauze or a soft sponge for cleaning.
3. Wear gloves when cleaning contaminated instruments.
4. When the lock of the instrument is kept in its locked possition, the joint of the instrument is difficult to access.

5. Open the lock of the instrument to make the joint accessible. Rotate the male part, so it can slip out of the female part. Do not use force to open the lock, since that might damage it.



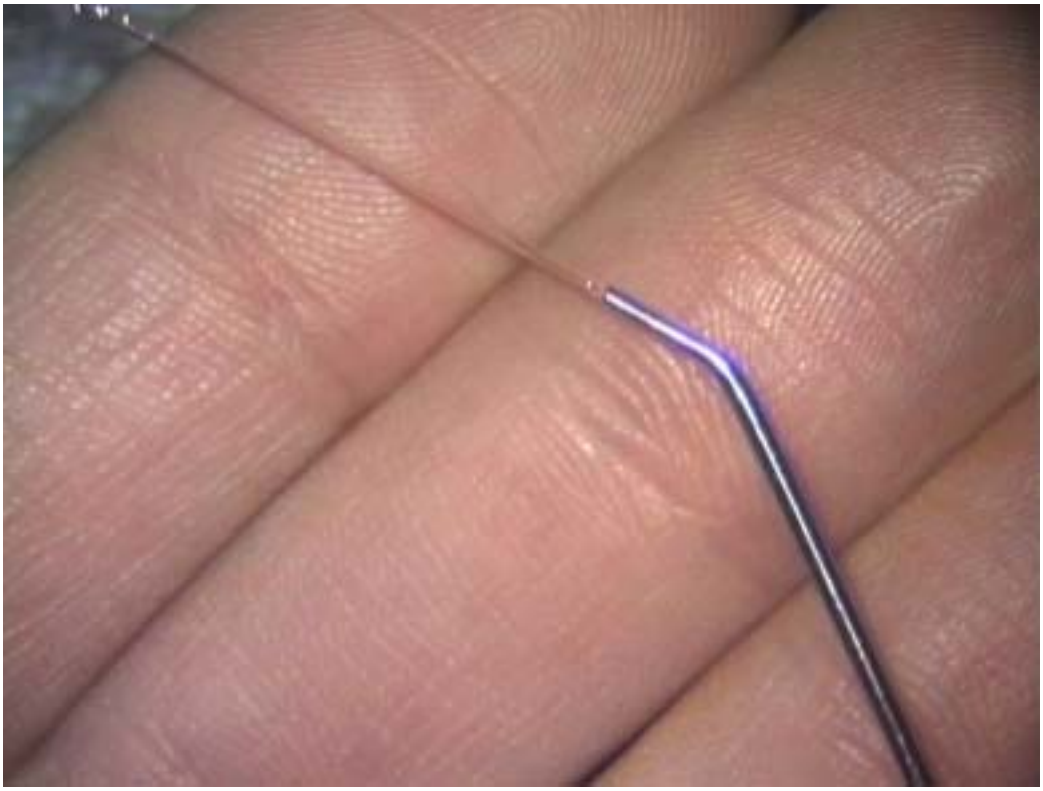
6. Soak the gauze/sponge in the water/soap solution.
7. Use gentle movements for cleaning. Don’t use force!



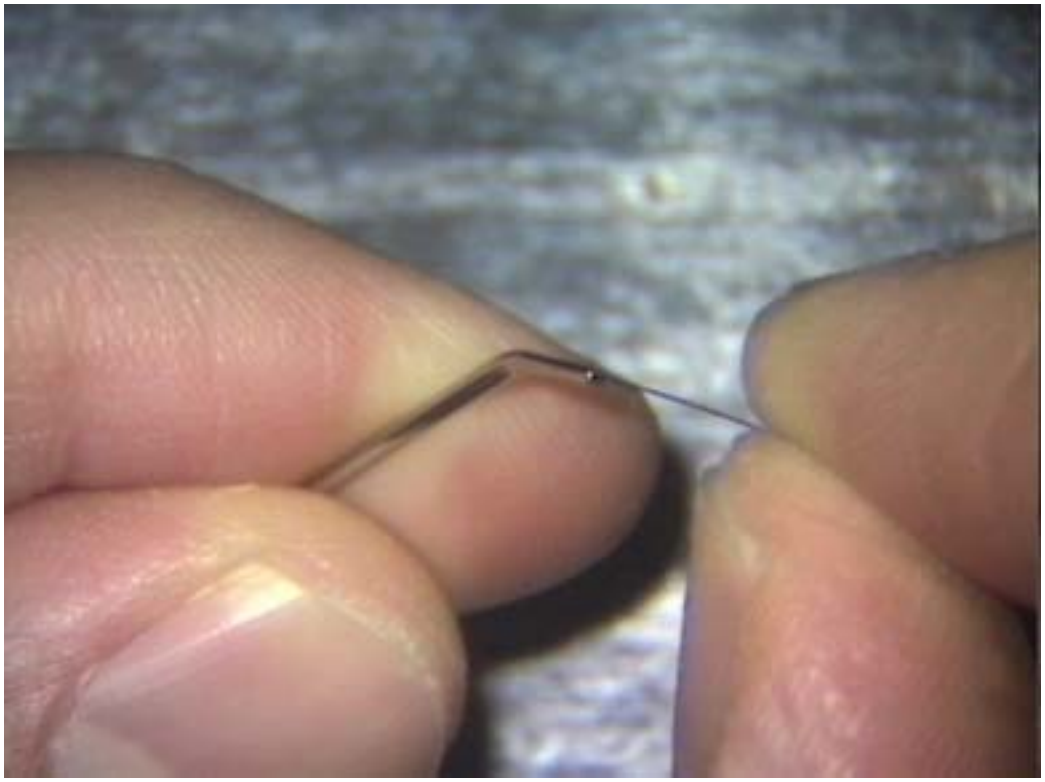
8. Rinse the instrument with clean water to remove the soap.
9. Dry the instrument with a soft cloth.
10. Store instruments in a secure way.

2.3 Cleaning a cannula

1. Flush a cannula immediately after use with clean water, to remove lensmaterial.



2. When cannula is blocked, use a small, fine piece of metal wire, to re-open the cannula. Use a soft type of metal wire, so the innerside of the cannula will not get scratched.



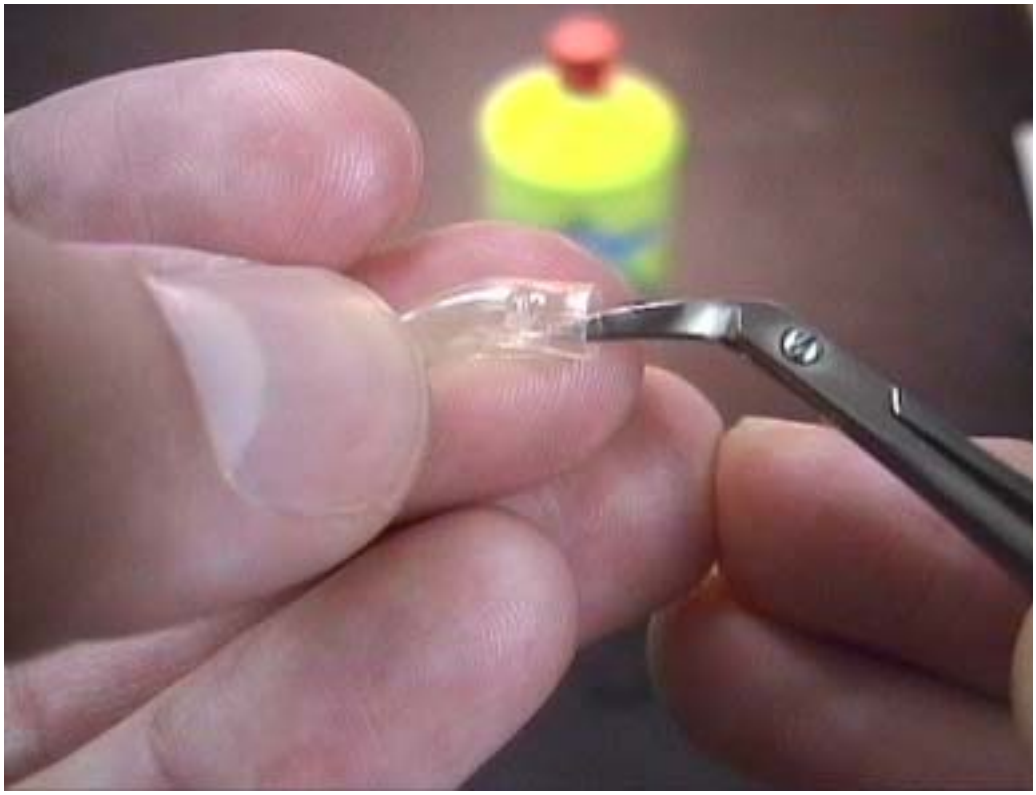
3. Storage and Transport

3.1 Transport

During transporttion of instruments (e.g. out reach activities, eye camps), they should be stored in special racks or trays with suitable fixation systems.

3.2 Protection of the tip

Protect the tips of the delicate instruments with a piece of silicone tubing. A piece from an IV set will do for that. The tip has to be covered completely by the tube. Make sure that the IV tube is also dry on the inner side.



3.3 Store instruments dry

To prevent rust formation, instruments should be stored dry. Never put instruments away when they are still wet. Store them in a dry place.

3.4 Precautions in humid areas

During the time humidity is high in a hot climate, surgical instruments, microscopes, slitlamps, ophthalmoscopes and lenses should be kept free of fungal growth. A way to protect these instruments is by using a monsoonbox. Put a small electric bulb (5-15 W/ 220V) into a closed cabinet or in a wooden box, which can cover microscope or slitlamp. The warm air has a lower relative humidity than the air at the ambient temperature.
Another way to protect instruments like ophthalmoscopes is to use a small bag with sillicagel. If these are not available, a small bag with dry rice can be used to absorb water from the humid air.

4. Rust formation

4.1 Causes of rust on stainless steel instruments

1. introduction
Most of the present day surgical instruments are made from stainless steel. However, this does not mean that they can not rust. Most of what is considered to be rust is just tissue, which has hardened into a yellowish-brown crust. This can be removed easily with good cleaning or a soft toothbrush. If the tissue stays on the instrument during autoclaving, after a while there will be corrosion at these spots.

2. Chromium plated instruments
Some of the old instruments are made out of chromium plated iron, when the chromium plating brakes off, the iron underneath it will start to rust. Sometimes the screws of instruments are made from a different material than the instrument itself, which can cause rust.

3. Precipitation of rust from other instruments
Iron and rust particles from other instruments are able to precipitate onto the stainless steel instruments in humid environments and in steam. Examples of these are a metal screw in the autoclave or old typed chromium plated instrument, which is already rusty. In order to prevent rust formation, iron instruments or rusty instruments should not be sterilised in the same autoclave as the stainless steel instruments. When iron instruments are sterilised in an autoclave, rust particles might stay inside the autoclave as well and precipitate on the stainless steel instruments during a following sterilisation. Never sterilise self-made instruments, which are not made out of good quality stainless steel together with the stainless steel instruments.

4. Tissue and blood
During surgery, blood cloths will stick inside the joint of an instrument. These blood cloths, which stay inside the joint of an instrument, will harden into a crust during autoclaving. This crust will be difficult to remove later on. Blood also contains iron, which can precipitate on the instruments as rust. To prevent this kind of crusts and rust formation, the instruments should be cleaned very well after surgery. Most microsurgical instruments have a lock at the back of the instrument. In order to clean well inside the joint, the instrument should be unlocked during the cleaning process (for details about cleaning see part 1).

5. Iodine
Instruments should never be sterilised with Iodine. Since this will result in small pits in the surface of the instrument.
Never leave instruments in saline. The salt will cause corrosion on the instrument.

6. Tension rupture
Rust can also be formed in a tension rupture in an instrument with a cremaillere lock at the back (e.g. mosquito forceps or big needle holders). If these instruments are autoclaved with the lock in its tightest position, there is a chance of a tension rupture in the joint. This tension rupture will be a place where rust formation can occur. To prevent the occurence of tension ruptures, make sure that an instrument with such a lock is always open or closed in its first position during autoclaving.

4.2 Removal of rust

Rust from a rusty instrument can precipitate on other instruments during sterilization. This makes it important to remove rust from the instrument as soon as possible. There are two major ways to remove the rust. One is to soak the instrument in Coca-Cola. This will remove some of the rust and will soften it, so the rest is easy to remove. The second way is to use a brass brush to remove it. The latter has the disadvantage that it may also scratch the metal a little, even though brash is a soft metal. The two methods can also be used combined.

4.2.1. Soften the rust with Coca-Cola

Rust on instruments can be softened by soaking the instrument in Coca-Cola. In this soda drink there is an acid which removes the rust, or at least softens it. Since the acid can also damage the metal of the instruments itself, the instrument should be soaked in the instrument for just a short period of time (less than 30 min.).

1. Poor some Coca-Cola in a bowl.

2. Take the instruments out the Coca-Cola within 30 min.

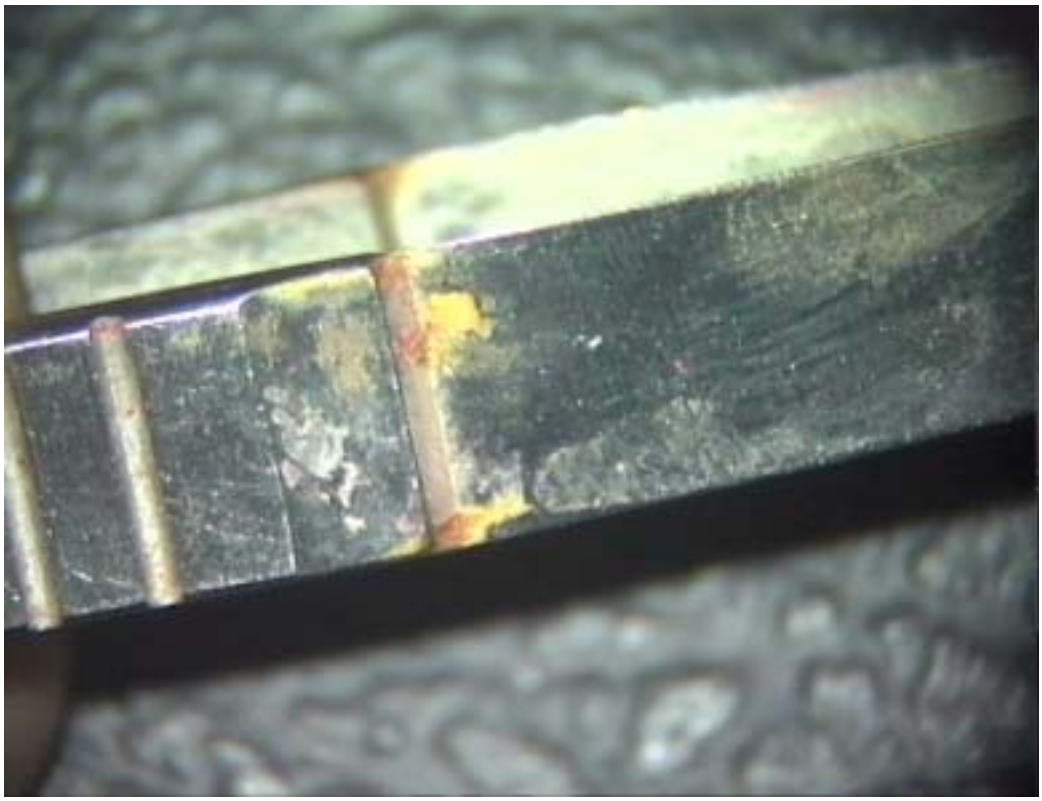
3. The rust can now be removed with good cleaning. Good cleaning is important to remove all rust and Coca-Cola.

4.2.2 remove rust with a brass brush.

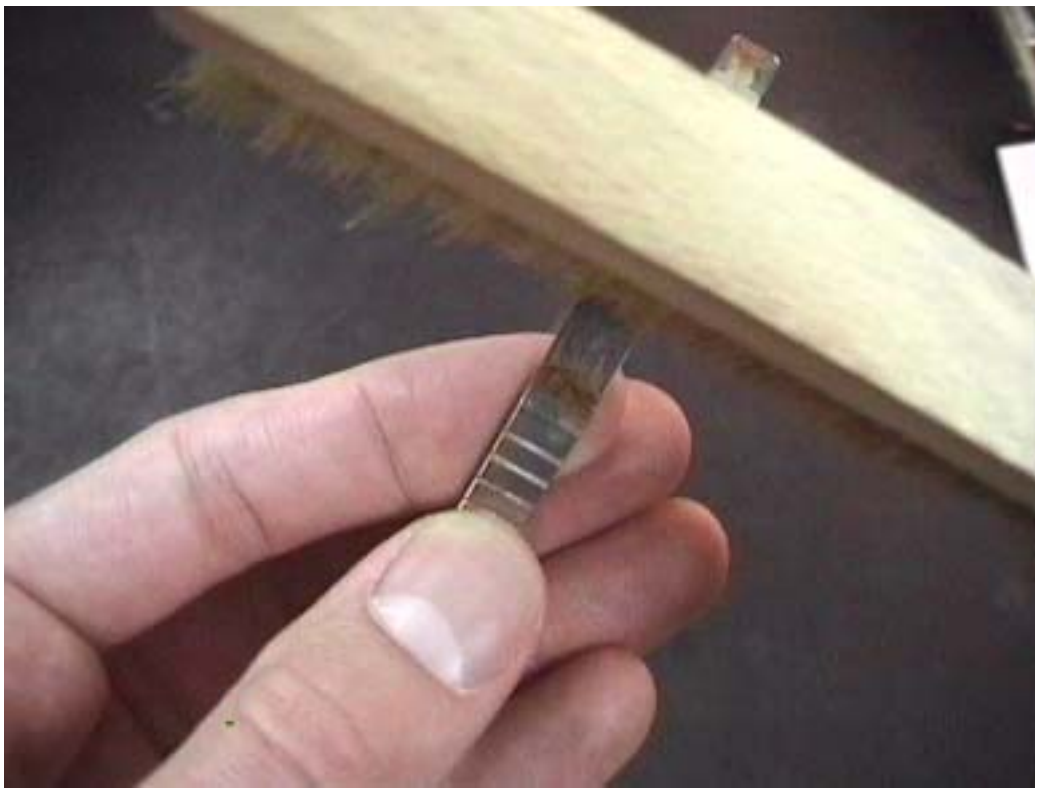
When rust is attached too strongly to the instrument Another way of removing rust from an instrument is using a brass brush.
Brass is a soft metal and does not damage the metal of the instument too much. Never the less, the brass brush should only be used for the handparts of instruments and the joint (care should be taken though not to touch the working part of the instrument, like the innersides and cutting edges of scissors.

1. Equipment used: brass brush.

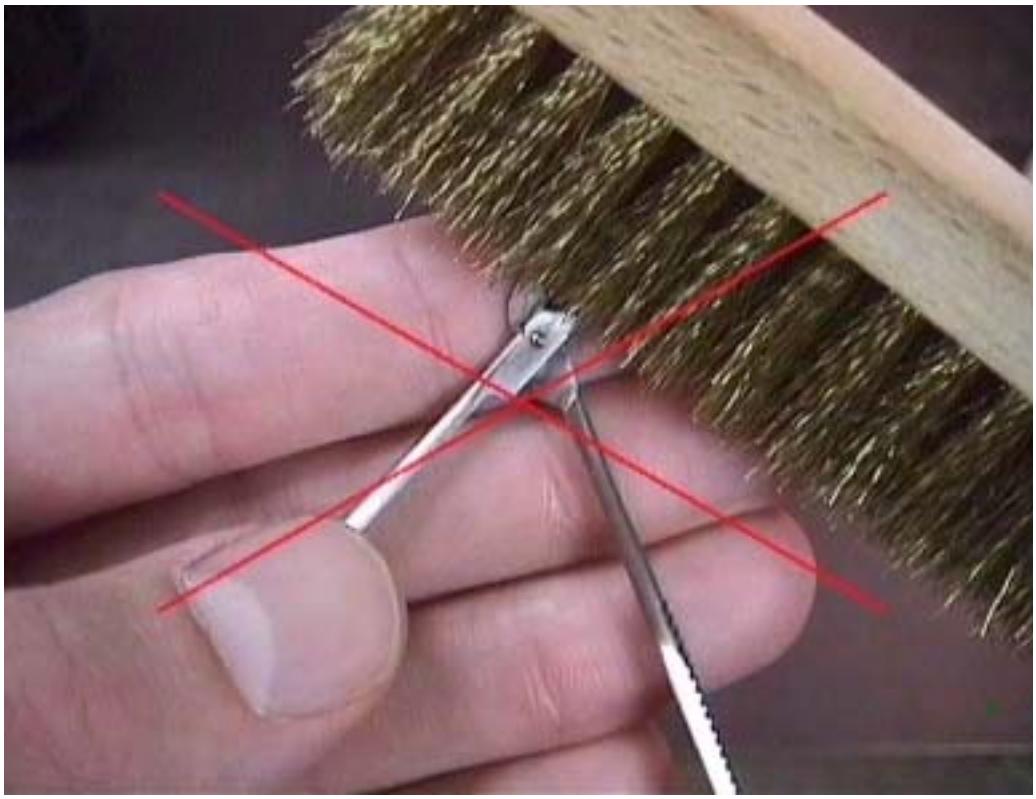
2. Rust on instrument.



3. Make gentle long strokes with the brush. Do not press the brush too hard on the instrument.



4. Do not use the brush on the working part of the instrument.



5. Result: the rust is removed from the instrument.

Repair of microsurgical instruments

5. Sharpening of scissors

To get the best result with wound healing, a nice straight incision has to be made. When blunt scissors are used, the tissue will be clasped instead of cut. This results in contusion of the tissue and reduced wound healing.

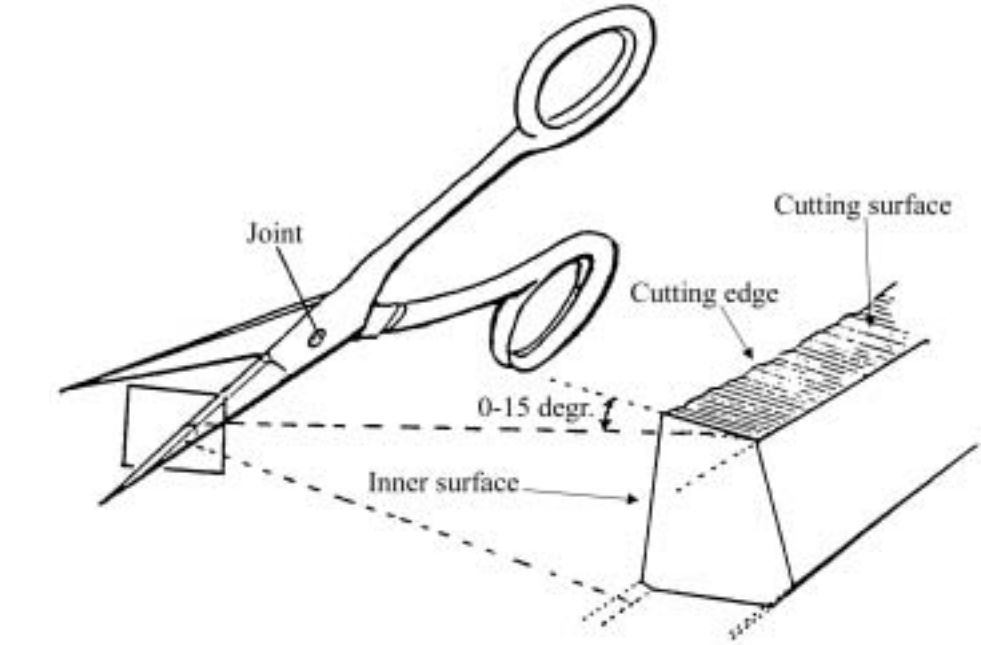
5.1 The way scissors work:

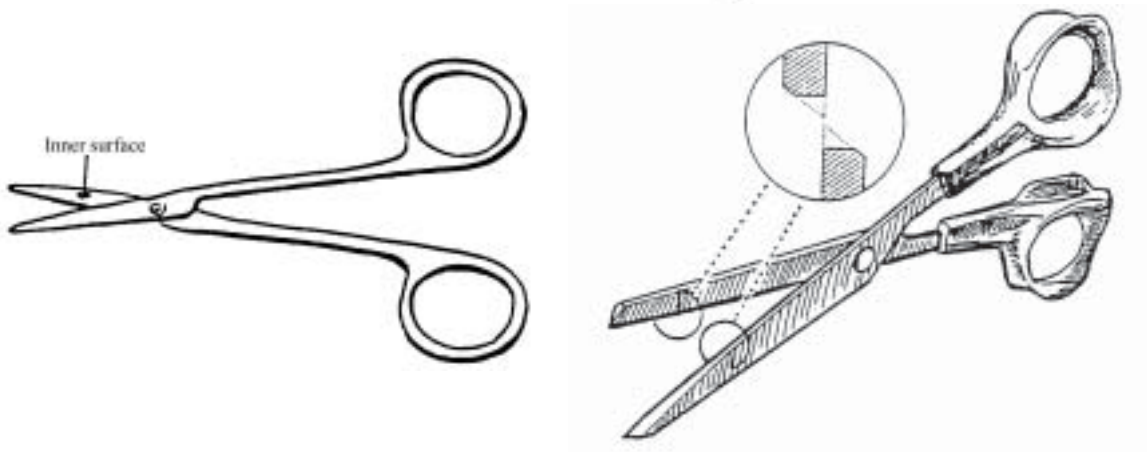
Scissors are made out of two blades, which are mirror images of each other. Each blade has two surfaces, which are of main importance:

- The inner surfaces, these slide over each other very smoothly and should never be touched
- The cutting or upper surfaces

The inner and cutting surfaces form the cutting edge. The two cutting edges, while sliding over each other, are cutting the tissue.

The angle of the cutting edge is usually between 0 and 15 degrees. The angle determines the sharpness of the scissors. If there is a very steep angle, the scissors will be extremely sharp, but can only cut soft tissue, like conjunctiva, otherwise it will get damaged. To cut harder tissue, the angle should be reduced to 0 degrees. This way the scissors will be able to cut harder tissue and stay sharp. The sharper the cutting edge, the quicker the scissors will get blunt.
Never use scissors for cutting material the are not made for! If hard material has to be cut, make sure the scissors are able to cut this (angle 0 degrees) or the scissors will get damaged (beyond repair!).



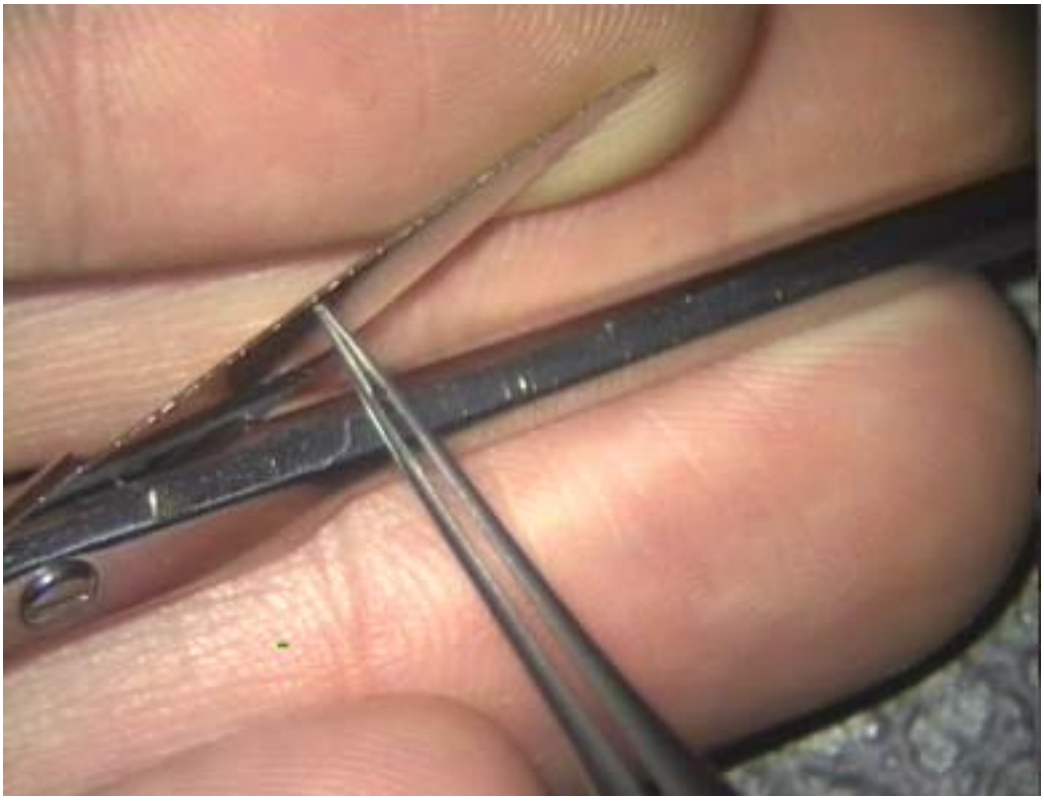


Angle cutting edge 90 degrees

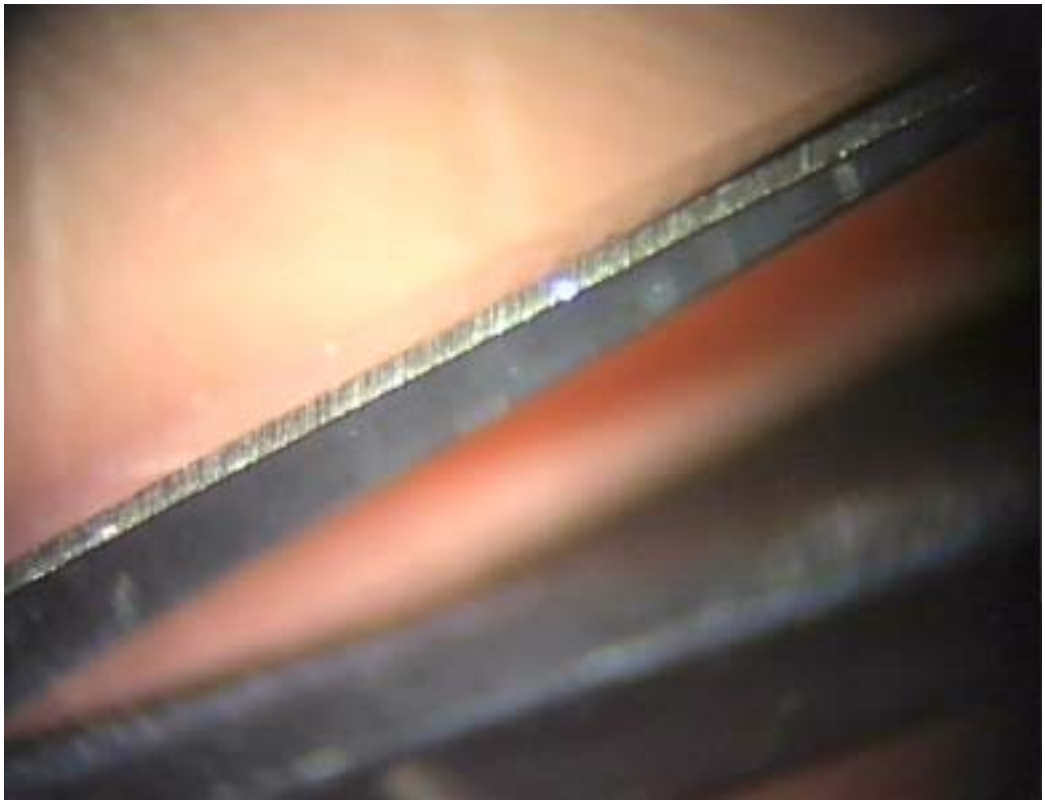
5.2 Blunt scissors

After using the scissors for a while, the sharp cutting edge will be rounded off and some pits will be formed in the cutting edge. The round edge and these pits can be made visible by shining a bright (desk) light on the cutting surface and let it reflect from the cutting edge. A sharp cutting edge will not reflect light, while pits and a blunt, round edge will reflect the light.
The result of the round edge and these pits will be that the cutting edges are not sliding smoothly over each other anymore. Tissue will now be clasped instead of cut.

1. Reflexion of several pits on cutting edge.



2. Enlargement of reflexion of a pit in cutting edge.



5.3 Testing a pair of scissors

To test a pair of scissors, use a piece of cotton wool. This material is so soft that it will not damage the scissors. Never use a piece of paper to test scissors, since this is a though material, which will damage the scissors. Stretch the cotton wool so a small straight piece is formed. Cut this piece, using the whole length of the scissors. Gently pull the cotton wool out, while the scissors are still in the closed position. If the scissors are working well, there should be a nice straight cut in the cotton wool. In case of the scissors clasping the cotton wool, the scissors are blunt, or the lock is too loose (see later).

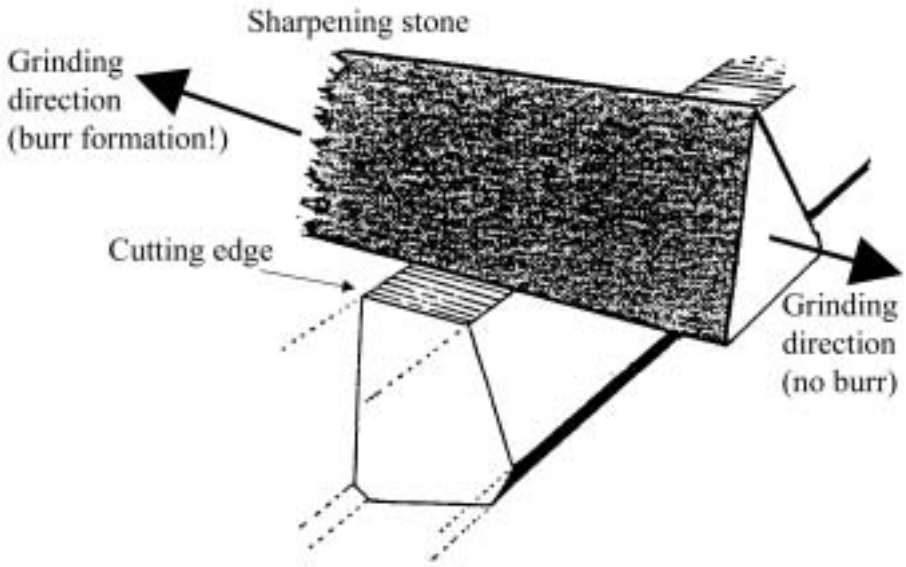
1. Cut a small piece of cotton wool with the scissors.

2. The cotton wool is clasped after the gentle removal of the cotton wool, the scissors are blunt.

3. A sharp pair of scissors give a nice, straight cut.

5.4 The basic principle of sharpening scissor

The basic principle of sharpening scissors is to recreate a new, sharp cutting edge. As said before, the inner surface is not to be touched during the procedure. A pair of scissors is sharpened, by filing off a tiny lair of the cutting surface, so a new cutting edge will be created. A special degusit triangular whetstone can be used or a triangular file (using a file will result in a rougher surface and consequently in a less sharp edge). To obtain the smoothest surface possible, a little sewing machine oil can be put on the sharpening stone. This will make the surface smoother and easier to clean the stone after sharpening. The easiest way to recreate the cutting surface, is to use the same angle it already had. Only if scissors are to be adjusted for different use, another angle can be created.



5.5 Sharpening scissors

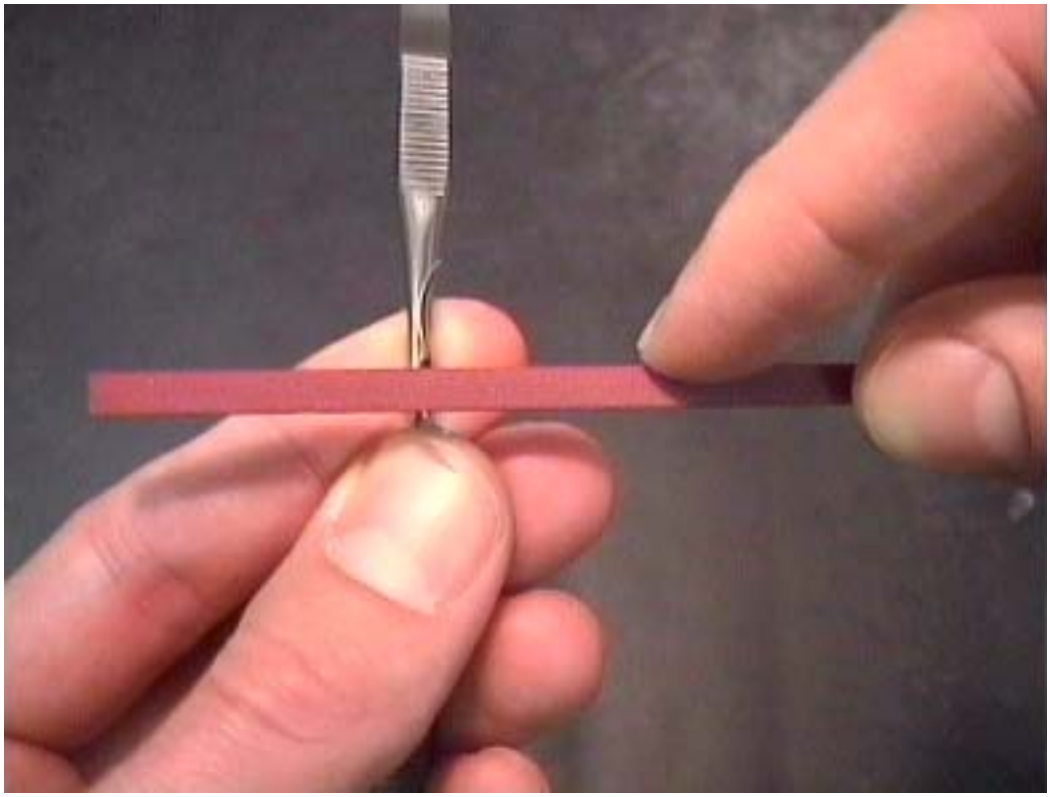
1. Holding the scissors

Hold the scissors firmly in one hand. If one is right handed, the scissors should be held in the left hand and the sharpening stone in the right (and vice versa for left handed persons). Let the tip of the scissor rest on the tip of the index finger, with the tip pointing towards the hand with the sharpening stone. Keep the joint open by pressing the thumb against the handpiece of the scissor.

2. Getting the right angle

In order to get the right angle; a bright desk light is used. Put the light at eye height and at the same distance from the scissors as the eye. Let the light reflect on the cutting surface. Rotate the scissors slowly in both directions. When the brightest light reflection is obtained, the surface is horizontal. If the sharpening stone is kept horizontal as well, the original angle will be recreated.

3. **Keep the sharpening stone horizontal**
Keep the sharpening stone horizontal during the whole sharpening procedure. When the angle of the stone changes during the procedure, the angle of the cutting surface will change as well!
Always start sharpening at the tip of the instrument, to prevent rounding off of the tip.
Make a gentle stroke in a forward direction and towards the joint. Make sure that the whole surface is covered during one stroke, so the whole surface stays smooth, and no levels are created. Do not use too much force. It should be the repetition of the movement, which sharpens the scissors.



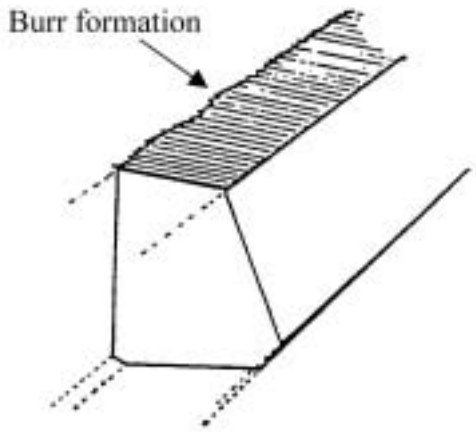
4. Sharpen the scissors till most of the reflections are gone. If the pits are too deep (due to unrightfully use of scissors), the amount that has to be filled off is so large that the risk exist that when proceeded, the tips of the scissors could not touch each other anymore. In that occasion try to sharpen as much as possible, to reduce the size of the pits.

5. **Sharpen the otherside**
Repeat the procedure for the other side. Always sharpen both sides.

6. **Clean scissors**
Clean the scissors thoroughly after sharpening (see chapter 2). There will be a lot of oil and metal remnants left on the instrument, which (if not removed) will cause huge inflammation in the eye.

5.6 Burr formation

When the sharpening movement is in the direction towards the inner surface (see drawings in paragraph 5.4), a burr will be formed on the inner surface. This burr has to be removed, if not it will damage the cutting edge on the opposite side, during cutting.



1. Removal of the burr.

The burr can be removed by scratching it off with ones nail. Make sure it is the nail that is scratching it off and not just the skin of the finger (this will not do!).

5.7 Loose joint

Another reason why scissors are not cutting, is a loose joint. If the screw is not tight anymore, the distance between the two inner surfaces will become too big. The cutting surfaces will not touch each other any more, and tissue will be clasped instead of cut.

5.7.1 Method 1(one person needed)

1. Open de lock at the back of the scissors (see 2.2.5).
2. Place the scissors down on a flat hard surface.
3. Press the two blades flat on top of eachother.
4. Hit with a small hamer on top of the rivethead.
5. Test scissors after every hit, to prevent scissors from becoming too tight.

5.7.2 Method 2 (two persons needed and a pendriver, all force of the hammer are directed towards the rivet, less chance on damaging other parts of the scissors)

1. Open the lock at the back of the scissors.
2. Place the scissors down on a flat hard surface.
3. Place the two blades flat on top of each other.
4. Put the tip of a pendriver on top of the rivet head, keep the pendriver perpendicular to the scissors.
5. Let someone else hit with a hammer on top of the pendriver.

6. Repair of needle holders

6.1 Introduction

A microsurgical needle holder consists of two parallel, smooth surfaces, which should touch each other over the whole surface. After using a pair of needle holders for a while, these surfaces might get worned out. When the needle holder is kept to the light in the closed position, no light should shine through its surfaces. If the light only shines through the middle part, the needle holder is worned out. If the light shines through the whole surface, it is probably bent.

6.2 test needle holders

To test needle holders grab a tiny hair on the back of the hand. The needle holder should be able to hold this hair. If the hair slips out of the needle holder, it is not functioning properly. The instrument should be examined carefully to diagnose the problem (worn out or bend).

6.3 Bend needle holders

When the needle holder is bend, this can be corrected. The side that is bend should be carefully rebend using a pair of flat tipped pliers. Do not use too much force, because the hardened metal might break.

1. Bend needleholders. Close the needle holder, and look at them from the side. If one side is sticking out, the needle holders are bend. Check which side is bend. Hold the scissors against the light and let the light shine through its surfaces, to check if one of the sides is bend in that direction.

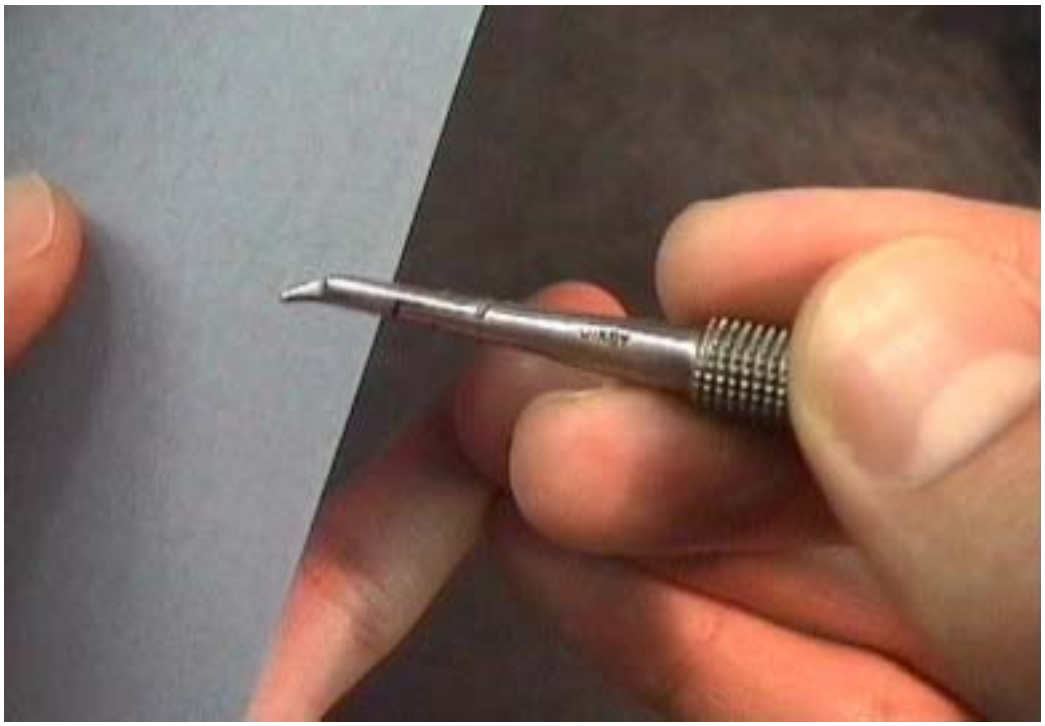
2. Rebend the bend side carefully, using a pair of flat tipped pliers. Do not use too much force.

3. Result after rebending

6.4 Worn out needle holders

The two surfaces need to be polished, to get realigned. This is done using a piece of very smooth sandpaper (roughness grade P1000 or higher).

1. Grab the sandpaper loosely with the needle holder. The sandpaper will now be parallel to the surfaces of the needle holder.



2. First polish one side, by moving the needle holders gently along the edge of the paper.
3. Release the paper from the needle holder and turn the needle holder around.
4. Polish the opposite surface
5. Test needle holder again.
6. If still not working, repeat step 1 to 5. If working properly, clean very well before use.

7. Repair of forceps

7.1 Different types of forceps

In the view of repair, there are basically four different types of forceps.

1. Toothed forceps

2. Knotched forceps

3. Suture tying forceps

4. Combined (toothed and suture tying) forceps

7.2 To test a pair of forceps

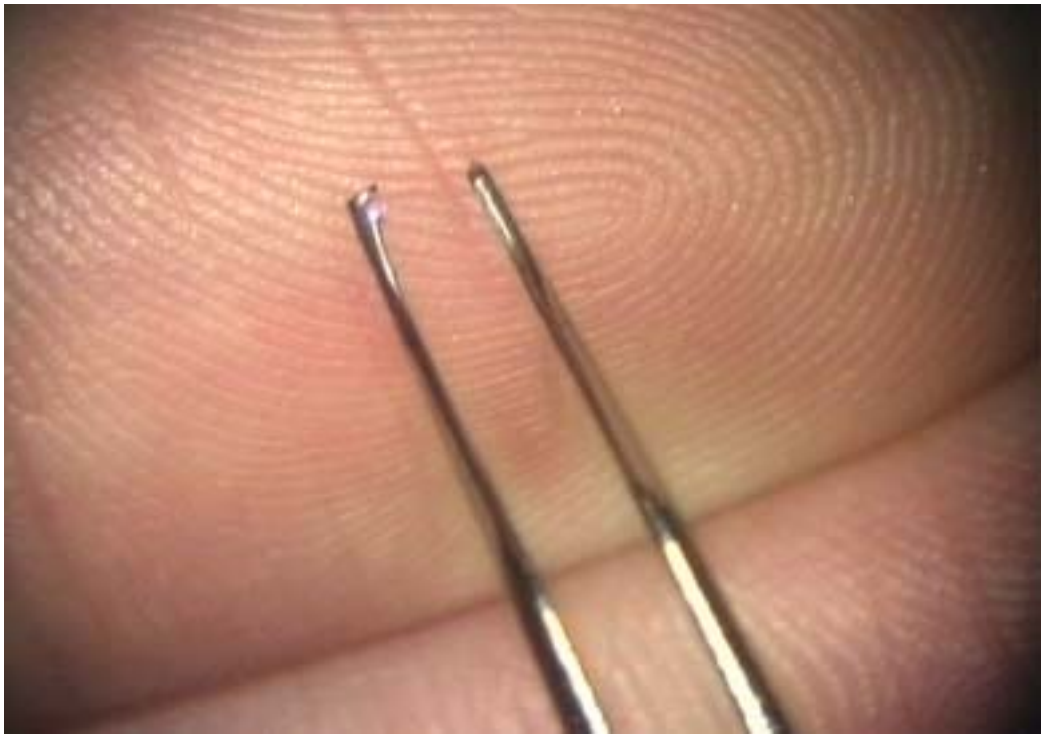
Hold the forceps in the normal way with two fingers. When closing the forceps, the tips should touch each other gently. If they don't, the side of the forceps, which is bent should be determined.
For testing suture tying forceps, see needle holder (6.2).

7.3 Straighten bend forceps

Bend forceps can be straightened by using a pair of flat tipped pliers. Grab the bend leg of the forceps and carefully rebend it. Do not use too much force! Test the forceps after each attempt. (see chapter 6.3)

7.4 Broken tip toothed and knotched forceps

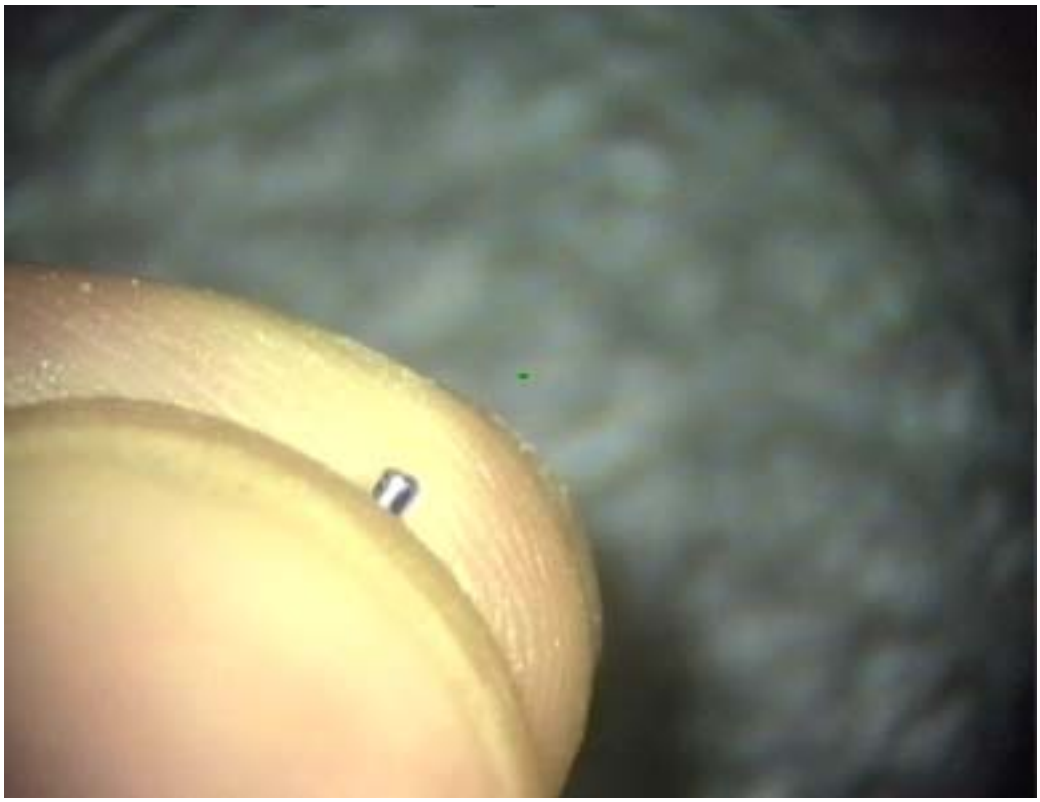
If the tip of one of the forceps is broken of, the forceps can be repaired and converted into a knotched forceps.



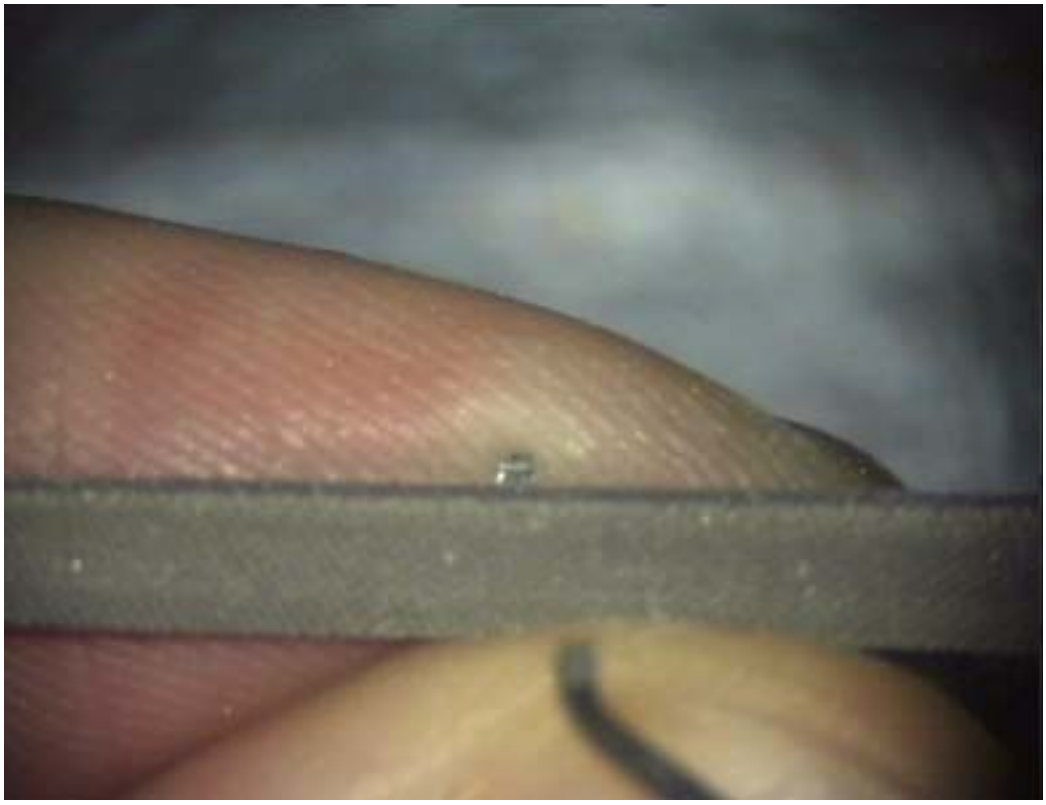
1. Make both legs the same length; use either a saw or a good quality side cutter.

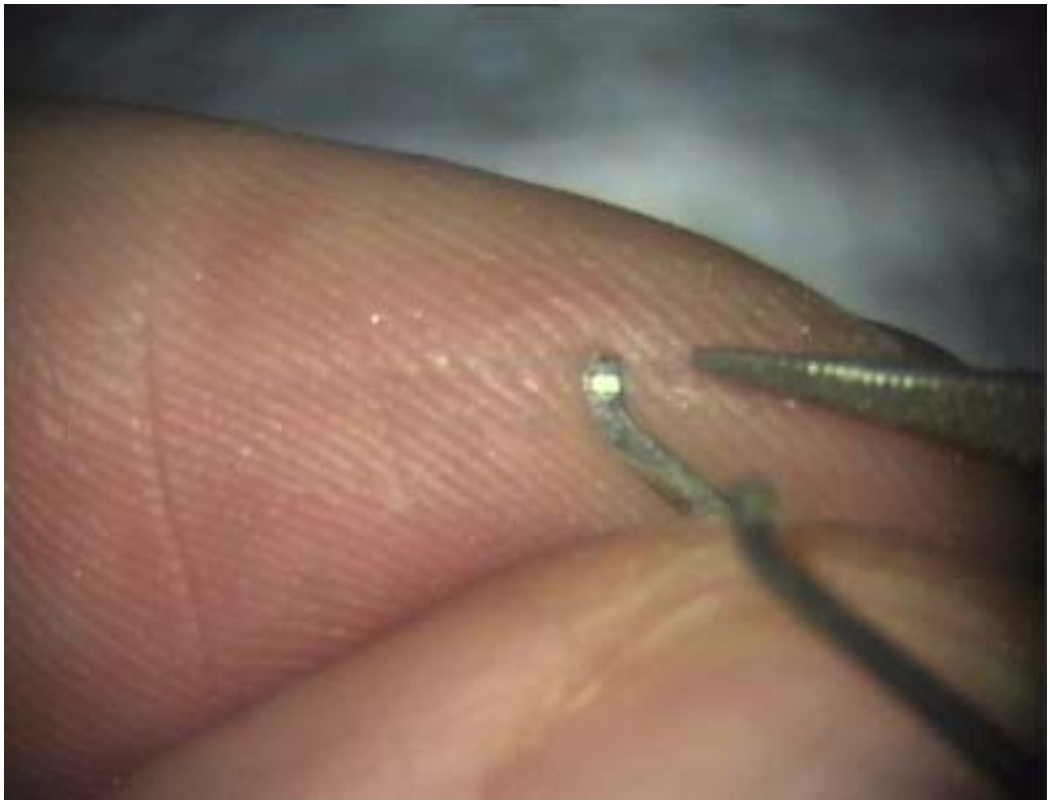
2. Smoothen both tips with a triangular file. Hold the tips of the forceps between thumb and index finger, this way the file cannot slip away.

3. Both legs of the forceps should be of equal length, with smooth tips.



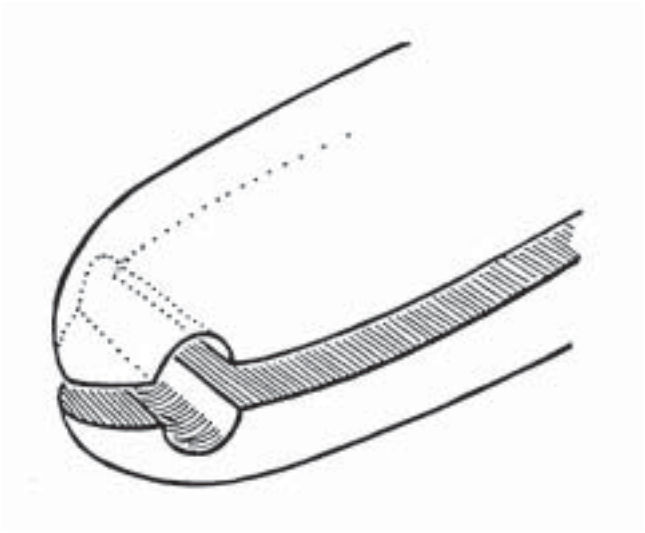
4. Make a groove on the first leg of the forceps, with one of the edges of the triangular file. The groove should be as close as possible to the tip of the forceps. Support the file with the thumb of the other hand, to prevent the file from slipping sideways.





5. Make a groove on the other leg of the forceps at the same distance from the tip as on the first side.

6. Smoothen the tips of the forceps, so there will be a small sharp tip left. There should not be a plateau at the tip in front of the groove, since this will not hold the tissue, but will let the tissue slip off.
On the photgraph below the amount of metal at the tip is still too much. The drawing gives the final result.



7.5 Suture tying forceps

For the repair of worn out suture tying forceps, the same technique as for needle holders can be used. (See 6.4 for instructions).

Special Tools required:
Degusit triangular whetstone:
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5431 SL Cuijk
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