

# Surgical Protocol

Prevention and management of post-op complications

3D Custom-Made Implants technique



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# PROTOCOL CONTENT

<b>INTRODUCTION</b>	3
<b>HAEMATOMAS</b>	3
Prevention	3
Early treatment	3
Delayed treatment	3
<b>SEROMA</b>	4
<b>INFECTION</b>	4
Prevention	4
Early treatment	5
<b>MIGRATION</b>	5
Prevention	5
Revision for migration	5
<b>FOLDING</b>	5
Rule	6
Folding prevention	6
Surgical revision	6
<b>CONTACTS</b>	7

## INTRODUCTION

This protocol intends to avoid complications that can occur, in particular due to a lack of experience. They become rare after a few cases, and most of the time, they can be corrected by a prompt revision or a secondary procedure.

None of these complications can be life-threatening or have function impact.

## HAEMATOMAS

The risk of hematoma is common to all invasive surgical procedures.

In congenital thoracic malformations, it is more common with large perforating vascular or muscle sections (pectus excavatum) than with atrophic perforating pedicles and no muscle sections (Poland syndrome).

It can be triggered in the immediate postoperative period by the gradient of depression of a suction drain which can remotely aspirate the coagulation clot from a large perforating pedicle (2nd-3rd intercostal space), even if placed at a distance from it, as the drain is between the two smooth planes of the rib cage and the implant.

### Prevention

Meticulous step-by-step total hemostasis during muscle section and detachment; this requires very good lighting with a cold-light headlight or on an illuminated retractor (Storz 9 cm). Short protected electrodes are used (to avoid burning the skin edges), followed by long electrodes (to reach the limits of the detachment). In the event of a persistent layer of bleeding after dissection, large abdominal compresses soaked in very hot saline can be introduced to activate clotting (transformation of fibrinogen into fibrin). Coagulation can then be completed with the electric knife in fulguration mode. Several checks are necessary to obtain a bloodless dissection plane and to be able to insert the implant, which is taken out of its sterile pouch at the last moment.

### Early treatment

Haematoma must be diagnosed early. It is obvious in the case of wall curvature, but it may be more discreet and hidden behind the implant. The warning sign is the persistence of blood staining after the first puncture. It is best not to hesitate to do a quick revision at the slightest doubt after an ultrasound control. The patient is taken back under general anaesthesia, the space is opened, the implant is removed, the haematoma is evacuated, the clot removed, washed and haemostasis is completed. In the event of an uncontrollable layer of bleeding, use the time necessary to first apply abdominal compresses soaked in very hot saline and then complete with the electric knife if necessary in fulguration mode. When the field is bloodless, the implant is reintroduced into its space and the three-plane closure is secured with absorbable sutures without drainage.

### Delayed treatment

Bleeding may occur after the patient has been discharged and has returned home in the following days, from a large perforator. Immediate revision in the face of obvious symptomatology with pain and abdominal curvature. A neglected haematoma would lead to fibrosis and then gradual retraction which would be difficult to release and treat surgically.

## SEROMA

A serous effusion is common postoperatively and may require one or more punctures in the dependent area on request, following the standard antiseptic precautions. It can be reduced or avoided by ensuring complete hemostasis and applying a firm postoperative compression 24/7 for one month.

## INFECTION

The risk of infection is common to any invasive surgical procedure but is compounded by the placement of a large foreign body in a prepared space. This risk is most often related to bacterial contamination by virulent pathogens (pathogenic *Staphylococcus aureus*) or saprophytes (*Cutibacterium acnes*) through a puncture or via the scar pathway near the caudal part of the implant.

### Prevention

Deterrent antibiotic therapy at induction: a 2 g injection of cefazolin.

Immediate placement of the implant in its space after removal from the sterile pouch and a final check of the sufficient haemostasis.

Closing in 3 separate planes:

- Suture of the muscle plane from top to bottom, with separate inverted stitches, using 0 absorbable suture (vicryl/polysorb), large needle. The knots are short and remain under the muscle. If there is no muscle in the lower part, an inverted stitch loads the deep subcutaneous fascia,
- Suture of the subcutaneous plane in separate inverted stitches with 3/0 monocryl suture. The knot is short (no braid), avoiding the exit of the strands towards the outside,
- The dermal-epidermal edges are sutured with intradermal monocryl 3/0 suture or glued (Dermabond).

The aim is to close the three planes perfectly tightly, without any risk of the sutures coming out and without the slightest space that could be a way in for saprophytic or virulent germs present or brought during dressing changes.

*Suction drainage to be avoided:*

A drain is not recommended in the vicinity of any implant because of the risk of contamination. The latter can be caused by the presence of saprophytic germs (especially in men in the hairy underarm) and which penetrate via the drain cutaneous orifice, irritated by movement and the fact it stays some days.

*Avoid changing dressings at home:*

The standard dressing applied in the theatre is changed on the day of discharge, after possible puncture, by the surgeon in charge, with reinforced precautions (antisepsis, sterile gloves, small lap sponges). A hydrocellular dressing is put in place for eight days (type mepilex border EM): no change at home, consultation after 8 days with the surgeon in charge and puncture if necessary. Removal of the dressing after 15 days.

*Seroma puncture:*

Always performed by the surgeon in charge with aseptic rules using a 19 Gauge trocar and 60 cc Luer-lock syringes. A clear serous fluid is reassuring, a cloudy fluid after the first three punctures will be subject to bacteriological sampling and antimicrobial susceptibility testing in aero-anaerobic environments.

## Early treatment

Serous effusion that is prolonged (beyond five punctures) and becomes cloudy should lead to a bacteriological sample and a blood test being taken.

In case of the presence of saprophytic germs (*Cutibacterium acnes* mostly), absence of clinical (fever, pain) and biological (SR, CRP, leucocytes) signs of infection, revision in the theatre with adapted antibiotic coverage can be decided and involves removal of the implant, abundant washing of the cavity and any pseudo membranes with saline solution (biofilm), reinsertion of the implant and closure (10-day antibiotic therapy).

In case of infectious signs and the presence of a pathogenic germ (*staphylococcus aureus*) the implant must be removed. It can no longer be resterilised (10-day antibiotic therapy).

A second surgery is possible within a minimum of 6 months with a new implant and appropriate antibiotic coverage.

## MIGRATION

The risk of post-operative migration of the implant out of its subfascial abdominal pocket is rare if the surgical protocol is closely followed. If the implant moves out of its initial position and its compartment, it may be visible under the epigastric skin in the lower areas not covered by the pectoralis major muscles.

It is particularly important to create the pocket deep enough, appropriately sized for the implant in the correct position, and following the markings to avoid any risk of migration. It is also crucial to properly insert the lower pole of the implant across the intermuscular septum, if present: in cases of diastasis of the rectus abdominis muscles, a simple subfascial placement is performed.

Special care must be taken during a Ravitch revision, as the muscular and aponeurotic planes may be altered or retracted, making deep dissection difficult, particularly in the abdominal area. In cases of herniation, it may be necessary to place a mesh to prevent the risk of migration. A drain can be indicated in case of difficult dissection.

## Prevention

- Strict adherence to the surgical protocol, especially in the upper abdominal region where the implant must be stabilised and its caudal apex covered by the fascia of the rectus abdominis muscles.
- If seroma collection occurs, punctures should be continued at the consultation each week until a decrease to less than 20 cc is achieved.
- Firm circular restraint with a chest belt and pad is maintained for one month 24/7.
- Any arm-involving sport is prohibited for three months, and up to one year for intense sports (climbing, rugby, wrestling, boxing, bodybuilding...).

## Revision for migration

Implant migration, most often caudal, beneath the abdominal skin, can occur due to difficulties or failure in performing the subfascial dissection. A reoperation is necessary to create the appropriate pocket and reposition the implant correctly

## FOLDING

Each custom implant has a firm, thick central part (filling) and a thin, very flexible lateral or caudal stabilizing apron.

## Rule

Avoid any visible fold beneath the skin by performing a thorough, slightly excessive dissection to allow the implant to lay flat.

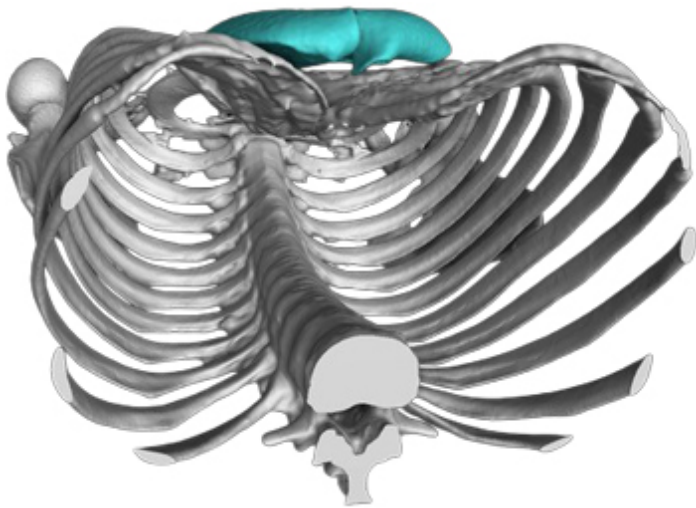
## Folding prevention

- Expand the dissection by 1–2 cm cranially and laterally, never caudally.
- Always check the implant's edge placement with finger or illuminated retractor.

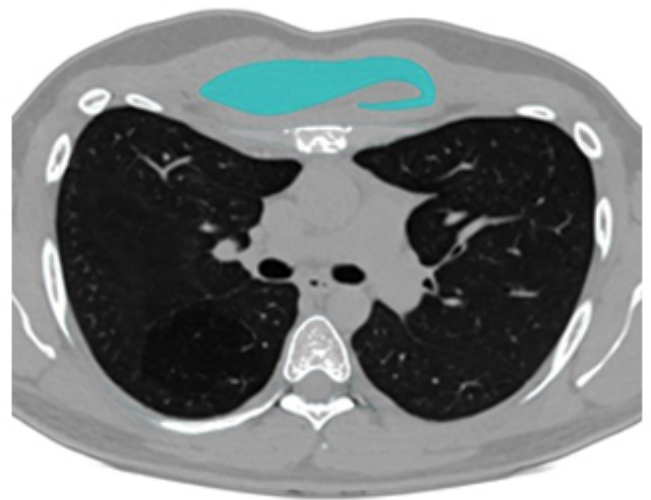
## Surgical revision

In case of a late and fixed folding: wait 3 months for the fibrous capsule to be formed around the implant.

- Moderate folding of the caudal apex visible under the abdominal skin (particularly in Pectus cases): the caudal end of the already stabilized implant can be directly approached and the protruding tip can be cut.
- Severe fixed folding of the implant on itself laterally or caudally: it is impossible to straighten or cut it. A new custom-made implant must be manufactured from a new CT scan and positioned correctly after removal of the old one and reconfiguration of the pocket.



Severe caudal folding



Severe lateral folding

## CONTACTS



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