Study protocol

Document date: 25.11.2024

Project title: NoPro - Norwegian Hernia Prophylaxis study: Onlay mesh versus small bite suture technique closure of midline laparotomies.

REK number: 761933

Project managers:

Gjertrud Hole Kjøstolfsen, MD, SIHF Hamar

Jorunn Skattum, MD PhD, SIHF Hamar

Jan Roland Lambrecht, MD PhD, SIHF Hamar

Revision history:

06.02.2025 – revision of exclution criteriae

18.02.2025 – removal of recommandation of postoperative hernia binder

Table of content

1. List of abbreviations
2. Title
3. Project group
4. Introduction
5. Aim
6. Study design
7. Sample size
8. Time frame
9. Inclusion criteriae
10. Exclusion criteriae
11. Description of consent
12. End of study
13. Procedure description
14. Patient data
15. Antibiotics
16. Thromboprophylaxis
17. Open abdomen/delayed closure of the fascia
18. Postoperative activity restrictions
19. Evaluation/follow up
20. Data storage and statistics
21. Ethics
22. Funding
23. Contact
24. Appendix
25. References

1) List of abbreviations

IH – incisional hernia
LoS – Length of stay
SIG – Sykehuset Innlandet Gjøvik (Gjøvik hospital)
SIH – Sykehuset Innlandet Hamar (Hamar hospital)
SIL – Sykehuset Innlandet Lillehammer (Lillehammer hospital)
SL/WL - suture length/wound length
SSO - surgical site occurrence
PM – prophylactic mesh
PROM – Patient Reported Outcome Measures
QoL – quality of life

2) NoPro

Norwegian Hernia Prophylaxis study: Onlay mesh versus small bite suture technique closure of midline laparotomies.

3) Project group

Gjertrud Hole Kjøstolfsen (GHK), GI resident at SIH
Jorunn Skattum (JS), consultant GI and Trauma surgeon at SIH, PhD. Project manager
Jan Roland Lambrecht (JRL), consultant GI surgeon at SIH, PhD.

4) Introduction

Incisional hernia (IH) is a defect in the abdominal wall at the position of a surgical scar that leads to a protrusion of abdominal content through the defect. It is a common complication after midline laparotomy with incidences ranging from 9 % to 40 % in the general population (1-11) and up to 69 % in high-risk patients (5,12-14). Incisional hernias can cause chronic pain, reduced quality of life (QoL) (15), impaired abdominal wall function and there is a risk of bowel obstruction, incarceration and ischemia. IH are also a great cost to the society (16,17). Several studies on IH prevention have been performed. An established intervention to avoid IH is to add a synthetic mesh to the suture closure of the abdomen after midline laparotomy. Meta-analyses have shown that the use of a prophylactic mesh significantly reduces the rate of IH after laparotomy compared with suture alone (18-22). Reported IH rates after onlay mesh closure of midline laparotomies are listed in Table 1 and in table 2 the corresponding numbers 5 years postoperatively are shown. Onlay mesh increases the risk of seroma compared to suture (RR 2.21), but the rate of wound infections (RR 1.32) and hematomas (RR 1.19) are comparable (22). The suture technique also matters and slowly absorbable monofilament suture at a 4:1 ratio to the incision length and small (5 mm) suture bites and steps also seems to be important to reduce IH rate after laparotomy (23). The mesh intervention is not frequently used in Norway and there are no Norwegian studies on IH prevention after midline laparotomy. There are two ongoing multicenter studies studying prophylactic mesh versus small stitch suture technique; the Finish PREEMER study compares retro-rectus mesh position to suture (24) and the German HULC trial studies onlay mesh versus suture in elective laparotomies (25). Hopefully the results will guide us on when to use prophylactic meshes on Norwegian patients. This study is an effort to contribute to our common knowledge, as well as to inspire Norwegian surgeons to consider using prophylactic meshes.

Table 1 – studies on IH after onlay mesh placement

Author	Type of study	Elective or emergency	% IH with suture	% IH with onlay mesh	Follow up
Hassan MA et al (21)	Meta-analysis	Elective 5 Emergency 1 Combined 1	32 %	10 %	mean 27 m median 24 m
Ulutas ME et al (26)	RCT	Emergency	27 %	4 %	12 m
Argudo N et al (27)	Retrospective analysis	Emergency	33 %	6 %	Mean 17 m

RCT= randomized controlled trial, IH = Incisional hernia, m= months

Table 2 – Five years results of IH after onlay mesh

Author	Type of study	Elective or emergency	% IH with suture	% IH with onlay mesh	Follow up
Caro-Tarrago A et al (28)	RCT	Elective	47 %	5 %	5 y
Van den Dop LM et al (PRIMA) (29)	RCT	Elective	53 %	25 % *	5 y

RCT= randomized controlled trial, IH = Incisional hernia, y= years

*10% of the patients in the onlay group did not receive a mesh

5) Aim

The primary endpoint is IH rate at 12 months after surgery in the midline laparotomy population at Sykehuset Innlandet (SI) comparing:

small stitch linea alba closure (study group A) to small stitch linea alba closure + onlay polypropylene mesh (study group B).
Secondary endpoints are:

- surgical site occurrences (SSO) in need of intervention (seromas, hematomas and wound infections)
- burst abdomen
- readmission rate and QoL at 30 days follow up (EQ-5D + VAS score) - QoL (EQ-5D and VAS score) at 12 months follow up.

6) Study design

The study design is experimental, with prospective randomization of all consenting consecutive patients that meet the inclusion criteria of having a midline laparotomy performed during their stay at SIH in the gastrointestinal and vascular surgical departments.

Patients treated at the gastrointestinal surgical departments at SIL will also be included and follow the same study protocol and criteria for inclusion. SIG might also attend the study.

Patients will be block randomized weekly. The project group members GHK and JS will perform the weekly randomization from closed envelopes every Monday morning and a sign will be placed at the OR entrance door, informing surgeons and OR nurses about the technique that should be performed that week. Group assignment will be blinded to the investigating radiologist as well as for the patients until the follow up at 12 months.

An interim analysis will be performed when 40 patients are included in each group. If the mesh has had to be removed in 20 patients or more, the study will be terminated.

7) Sample size

Based on results from comparable studies listed in Table 1 (onlay mesh versus suture) we estimate an IH rate of 30 % in group A and 10% in group B. We add on 20% loss to follow up at 12 months follow up due to the nature and known mortality rate in the emergency patient population amounting to about 70% of the laparotomies performed at SIH in 2023. With an alpha = 0.05 and power of 80% the number of patients needed in the study groups are 62 + 12 in each group, in total about 150 patients. If the loss to follow up turns out to be higher than 20%, the number of included patients will be increased accordingly.

8) Time frame

We plan to start the study in the autumn of 2024 after study approval and after training the involved surgeons and OR nurses in both the small stitch suture technique and the mesh application technique. We estimate inclusion to be complete at the end of 2026 and follow up at the end of 2027. During the following 6 months data will be analysed and the study results submitted for publication at the end of 2028.

9) Inclusion criteria

Surgery predominantly done by midline laparotomy
Age ≥ 18 years
Written consent by patient/family
Midline laparotomy with delayed closure
No exclusion criteria

10) Exclusion criteria

Age < 18 years
Pregnancy
Previous abdominal midline hernia mesh repair
Abdominal compartment syndrome
Linea alba closure not possible
Hernia in the midline with transverse diameter > 2 cm
Life expectancy < 6 months

11) Description of consent

Patients will be asked to participate in the study at the outpatient clinic or during their stay at the ward before surgery. Written consent is mandatory to be included in the study. The participants can at any time withdraw their consent. The patient data will from then on not be used in future analysis. If the anonymous data at the time is already included in the analysis, the data will not be deleted.

<u>Elective surgery</u>
The patients who are included in an elective setting will in most cases be identified at the outpatient clinic by a surgeon. This is not necessarily the same surgeon who will perform the surgery on the operating day. The patient will give consent to a resident, a junior doctor or a nurse either at the outpatient clinic when the medical record is taken or when the patient arrives at the ward before surgery. By not involving the

operating surgeon in this matter, the pressure of participating in the study will be reduced.

In some cases, the planned procedure of laparoscopy will be converted to a midline laparotomy perioperatively. If there is a high risk of conversion preoperatively, the patient will be offered to participate in the study given that the surgery is converted to a laparotomy.

Emergency surgery

The risk of developing IH after an emergency surgery is increased (OR 4.7 Cl 3.9-5.5) (30). The two studies published on onlay prophylactic synthetic mesh in emergency laparotomies show a reduction in IH in the mesh group (4% and 6%) compared to the group closed with suture alone (27,4% and 33%) (26,27). One study also shows a reduction in burst abdomen within the first 30 postoperative days (31). The current guidelines of European Hernia Society (EHS) and American Hernia Society (AHS) (32) make no recommendation regarding prophylactic mesh reinforcement in emergency laparotomy as "the data on mesh augmentation are heterogeneous and limited". The guidelines states "More research is needed to draw definitive conclusions on potential benefits of mesh augmentation in patients undergoing emergency midline laparotomy and to identify subgroups of patients who might benefit from prophylactic mesh placement».

In our opinion it is critical to include emergency laparotomies in this study as this is the patient group where surgeons are most reluctant to implement prophylactic mesh even though these patients are probably benefiting the most from reinforcement. Some of these patients will not be able to be included in the study due to the urgency of the operation or the state of the patient. However, patients with Glasgow Coma Scale score 15 that can confirm why they need surgery and what the treatment plan is, will generally be eligible for study inclusion if there is time before surgery. As in an elective setting, the patient will give his consent to the resident, the junior doctor or the nurse on call and not to the operating surgeon, to reduce the patients perceived pressure to consent to the study.

12) End of study

The study will end when the desired numbers of participants have been included (150).

The study will be terminated if:

- The estimated inclusion timespan doubles from 1,5 years to more than 3 years.

- More than 30% of patients are lost to follow up during the first 12 months of the inclusion period significantly impacting on the estimated timeframe of the study.

- Interim analyses after 40 included patients in both study groups reveals that 20 patients or more have had to have the mesh removed.

13) Procedure description

<u>Study group A: small stitch suture closure of linea alba</u>

Closure of linea alba will be performed according to EHS guidelines (32):
Slowly absorbable monofilament 0 suture (PDS plus 0) is used. The fascia is closed by running suture with minimum 4:1 suture: incision length ratio with small bites technique (stitches 5 mm apart, 5-9 mm stitch depth on both sides, see Figure 1). Self-locking nots are tied in both ends of the suture line. A subcutaneous drain is used at the discretion of the surgeon and the skin is closed with skin clips.

The subcutaneous drain will be removed according to standard postoperative treatment, typically when output is below 30-50 ml/24 hours, and skin clips 10-14 days postoperative in patients without signs of SSI. The OR nurse will together with the surgeon, measure used suture material and incision length on individual patients and the data will be written on a registration form for each patient.

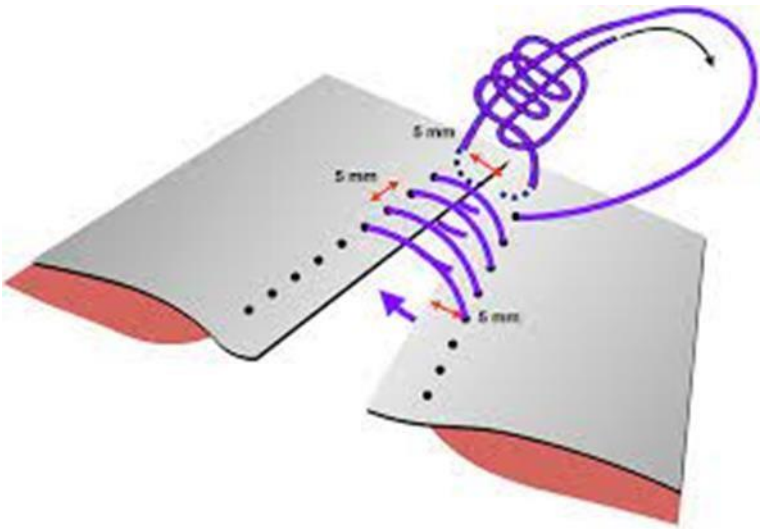

Figure 1

Study group B: small stitch suture closure of linea alba + onlay polypropylene mesh
(Macroporous Polypropylene Mesh)

The same suture technique and suture material as described for study group A is used in study group B to close linea alba. The anterior rectus fascia is dissected 3 centimetres in all directions from the incision and a macroporous polypropylene mesh cut to fit this area is then applied (Figure 2), overlapping fascial edges by 3 cm in all directions as shown on Figure 2. The mesh used are cut from 15 cm x 15 cm meshes and if the incision is longer than 9 cm, more than one stripe is needed to cover the suture line, and the mesh stripes will overlap 3 cm. The mesh will be sutured to the fascia by interrupted PDS 2.0 stitches 3 cm apart around the circumference of the mesh. A subcutaneous drain is placed on top of the mesh before the skin is closed with skin clips. The drain will be removed after 2-5 days according to output below 30-50 ml/24 hours. Skin clips will be removed after 10-14 days in patients without signs of subcutaneous infections.
The OR nurse will together with the surgeons, measure used suture material and incision length on individual patients and the data will be written on a registration form for each patient.

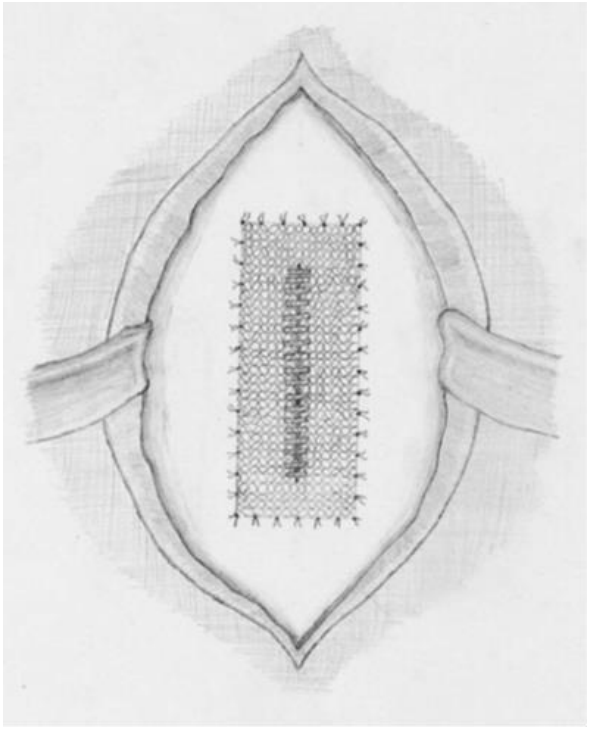

Figure 2

14) Patient data

Demographic and clinical data that will be registered from electronic patients' charts are:

Age
Gender
Work/profession (physical or non-physical)
Medication (immunosuppression/steroids)
ASA
Diabetes Mellitus
Connective tissue disease
BMI
Smoking
Elective/Planned vs emergency surgery
Surgical procedure performed
Contamination classification (1-4)
Antibiotics (prophylactic/treatment, type?)
Surgery time
Length of stay (LOS)
Subcutaneous drain removed on day number
Intervention: Suture or Mesh
Suture length
Incision length
SL/WL
Burst abdomen
Sick leave
Discharge to home or home care facility
Clavien Dindo complication grade ≥ 3 during hospital stay
SSO intervention

15) Antibiotics

All patients receive prophylactic antibiotics or treatment according to procedure and status, typically Cefalotin 2g in vascular procedures and Doxycyklin 400 mg + Metronidazole 1g in GI procedures, alternatively Piperacillin Tazobactam treatment in contaminated and/or emergency patients with contaminated abdominal cavity.

16) Thromboprophylaxis

All patients receive anticoagulation treatment as decided by the surgeon. Typically, low molecular weight heparin (LMWH) after surgery for at least 10 days (4 weeks

after cancer surgery). Vascular procedures are often followed by platelet inhibition after discharge.

17) "Open abdomen" / Delayed closure of the fascia

In the situations where the laparotomies cannot be closed primarily, the patients will be randomized initially at the time of the primary operation and then closed according to the assigned group at the final closure of the fascia.

18) Reoperation within the first 12 months

In the event of relaparotomy after initial closure within the first 12 months, the patient is further analysed as part of his original group (A and B) as in intention to treat manner. If a patient is reoperated due to burst abdomen, a mesh will likely be added for patients in group A (standard suture closure without mesh). These patients are also further analysed as a part of their original randomized group as in intention to treat manner.

19) Postoperative activity restrictions

All patients will have physiotherapist-guided mobilization after surgery focusing on unstrained (low abdominal pressure) mobilization for 8 weeks after surgery.

20) Evaluation/Follow up

Patients will be interviewed and examined 4-6 weeks and 12 months after surgery in the outpatient clinic. In cases where the patient cannot show up to a clinical examination, a telephone interview will be performed. Incisional hernia occurrence will be evaluated clinically and by CT examination after 12 months. A QoL (EQ-5D) score and VAS-score will be performed preoperatively in patients scheduled for elective surgery. This cannot be performed in emergent cases due to considerable bias implicated by acute illness and the need for surgery. QoL (EQ-5D) score will be calculated at the scheduled postoperative follow ups in all patients. Total length of sick leave will also be registered as well as average pain over the last 24-48 hours measured by VAS-score. Any sign of symptomatic SSO will be further explored by ultrasound or CT scan at 4-6 weeks follow up.

In the application for study approval by the regional ethics committee and the local data protection officer, we will apply for storage of data over time to perform longterm follow up as well (5 years follow up). In accordance, we will ask for written consent from the patients to contact them after one and five years postoperatively.

21) Data storage and statistics

Registration forms will be stored in coded lockers in the department. Extracted data from electronical medical charts (DIPS extracted data) will be entered with identification code into Excel and thereafter transferred for analyses into SPSS. We might use LEDIDI for data storage if this system becomes available during the study period. The identification code will be stored separately on a safe institutional server domain approved and provided by the hospital.

Descriptive data analyses will be performed.

Continuous data will be analysed by Mann-Whitney U test and multiple logistic regression.

Categorical data will be analysed by Chi-Square tests and multiple logistic regression.

Kaplan-Meier analyses for IH rate comparison will be conducted.

Interim analyses of group differences will be performed as Mann-Whitney U test or Chi-Square tests as appropriate.

22) Ethics

Study approval will be applied to the regional ethics committee and the local data protection officer.

All patients will receive standard care in abdominal wall closure, but group B patients will probably benefit from the additional mesh by a potential reduced risk of IH after surgery. The previous studies conducted on onlay prophylactic mesh (21,26-29) show a significant reduction in IH rate with the use of a prophylactic mesh. As data are not considered strong enough by the hernia society in Europe or USA to strongly recommend the use of prophylactic meshes (32), we cannot claim to deprive some patients of better outcome by not giving them a mesh prophylaxis.

In our experience most Norwegian surgeons are reluctant to apply prophylactic meshes as they are not familiar with the method and afraid of infections. It is our belief that if it were not for the participation of this study, most of the patients would not receive a prophylactic mesh as it is not the standard of care today. We hope that this study will contribute to increase the use of prophylactic mesh in midline laparotomies and create more awareness of the procedure to the general Norwegian surgeons.

Seroma and infections

As previous studies have shown that implementation of prophylactic onlay mesh increases the risk of seroma, some of the patients in study group B may receive an unnecessary complication. However, we believe that the benefit of reducing IH is greater than the possible risk for this non-serious complication that in most cases may be resolved either spontaneously or by bedside procedures.

The mesh is made of inert large pore material (polypropylene) that facilitates good vascular ingrowth which makes the resistance to infection good due to antibiotic penetration in vascularized tissue. The mesh can easily be removed with a surgical procedure in local or general anaesthesia. Fluid accumulation around the mesh (seroma) is probably prevented by adding a subcutaneous suction drain that are removed with a slight discomfort (with oral or iv pain medication) after a few days. In most cases the drains are removed without pain due to the epidural anaesthesia most of the patients have the first days after laparotomy.

Mesh infections are rare, and the incidence of mesh removal is low in published studies (21,26,27,29). The risk of a potential harmful procedure performed in general anaesthesia is therefore very small. By choosing onlay position of the mesh, the risk of organ injury in a reoperation is reduced and the layers used for potential later hernia repair preserved.

Excluded groups

We have chosen to exclude pregnant woman, children and patients who have previously gone through abdominal midline hernia mesh repair from the study. There are no studies conducted on pregnant women or children on this matter. Pregnant women and children have abdominal walls that are, respectively, expanding and a rupture or tear of the abdominal wall next to a fixed area (the edge of the mesh) is possible. The patients previously treated for abdominal midline hernia mesh repair need a different closing technique after laparotomy, and these patients are therefore not eligible for this study.

23) Funding

The added cost generated by the study is estimated to:

- about 15 minutes OR time (58)
- about 300 NOK in added materials (mesh + drain)
- outpatient clinic appointment at 12 months
- CT scan at 12 months
- SPSS, LEDIDI licenses or similar for 1-2 study group members

These costs are funded by the surgical department and signed for by the director of the surgical department, Lars Martin Rekkedal.

24) Contact

Gjertrud Hole Kjøstolfsen, MD, gjertrud.hole.kjostolfsen@sykehuset-innlandet.no.
M +47 46432356

Jorunn Skattum, MD PhD, jorunn.skattum@sykehuset-innlandet.no.
M +47 93253940

Jan Roland Lambrecht, MD PhD, jan.lambrecht@sykehuset-innlandet.no.
M +47 99703962

25) Appendix

- Consent form
- Registration forms

26) References

1. Diener MK, Voss S, Jensen K et al. Elective midline laparotomy closure: the INLINE systematic review and meta-analysis. Ann Surg 2010 251:843-856
2. Fink C, Baumann P, Wente MN et al. Incisional hernia rate 3 years after midline laparotomy. Br J Surg 2014 101:51-54
3. Albertsmeier M, Seiler CM, Fischer et al. Evaluation of the safety and efficacy of MonoMax suture material for abdominal wall closure after primary midline laparotomy – a controlled prospective multicentre trial: ISSAAC [NCT005725079]. Langenbecks Arch Surg 2012 397: 363-371
4. Seiler CM, Bruckner T, Diener MK et al. Interrupted or continuous slowly absorbable sutures for closure of primary elective midline abdominal incisions: a multicenter randomized trial (INSECT: ISRCTN24023541). Ann Surg 2009 249:576-582
5. Pereira JA, Pera M, Grande L. Incidence of incisional hernia after open and laparoscopic colorectal cancer resection (Spanish language). Cir Esp 2013 91:44-49
6. Claes K, Beckers R, Heindryckx E et al. Retrospective observational study on the incidence of incisional hernias after colorectal carcinoma resection with follow-up CT scan. Hernia 2014 18(6):797-802
7. Bloemen A, Van Dooren P, Huizinga BF et al. Comparison of ultrasonography and physical examination in the diagnosis of incisional hernia in a prospective study. Hernia 2012 16:53-57
8. Bosanquet DC, Ansell T, Aboelrahman T et al. Systematic review and meta regression of of factors affecting midline incisional hernia rates: an analysis of 14,618 patients. Hernia 2014 18 (suppl 2):S12-S15
9. Deerenberg EB, Harlaar JJ, Steyerberg EW, Lont HE. Small bites versus large bites for closure of abdominal midline incisions (STITCH): a double-blind, multicentre, randomised controlled trial. Lancet 2015 386(10000):1254–1260

10. Llaguna OH, Avgerinos DV, Nagda P et al. Does prophylactic biologic mesh placement protect against the development of incisional hernia in high-risk patients? World J Surge 2011 35(7): 1651-1655
11. Argudo N, Pera M, Lopez-Cano M et al. Selective mesh augmentation to prevent incisional hernias in open colorectal surgery is safe and cost-effective. Front Surg 2018 5:8
12. den Hartog D, Dur AHM, Kamphuis AGA et al. Comparison of ultrasonography with computed tomography in the diagnosis of incisional hernias. Hernia 2009 13:45-48
13. Alnassar S, Bawahab M, Abdoh A et al. Incisional hernia postrepair of abdominal aortic occlusive and aneurysmal disease: five years incidence. Vascular 2012 20:273277
14. Pereira-Rodríguez JA, Amador-Gil S, Bravo-Salva A. Implementing a protocol to prevent incisional hernia in high-risk patients: a mesh is a powerful tool**.** Hernia 2022 Apr;26(2):457-466.
15. Van Ramshorst G, Eker HH, Hop WCJ et al. Impact of incisional hernia on healthrelated quality of life and body image: a prospective cohort study. Am J Surg. 2012 Aug;204(2):144-150
16. Fischer JP, Basta MN, Mirzabeigi MN et al. A Risk model and Cost analysis of Incisional Hernia after Elective, Abdominal Surgery based Upon 12,373 cases. Ann Surge 2016 May; 263 (5): 1010-1017.
17. Gillion J-F, Sanders D, Miserez M et al. The economic burden of incisional ventral hernia repair: a multicentric cost analysis. Hernia 2016 20, 819-830
18. Bhangu A, Fitzgerald JE, Singh P et al. Systematic review and meta-analysis of prophylactic mesh placement for incisional hernia following midline laparotomy. Hernia 2013 17(4):445-455
19. Jairam AP, López-Cano M, Garcia-Alamino JM et al. Prevention of incisional hernia after midline laparotomy with prophylactic mesh reinforcement: a meta-analysis and trial sequential analysis. BJS Open 2020 Jun; 4 (3):357-368
20. Payne R, Aldwinckle J et Ward S. Meta-analysis of randomised trials comparing the use of prophylactic mesh to standard midline closure in the reduction of incisional herniae. Hernia 2017 Dec;21(6):843-853
21. Hassan MA, Yunus RM, Khan S et al. Prophylactic Onlay Mesh Repair (POMR) Versus Primary Suture Repair (PSR) for Prevention of Incisional Hernia (IH) After Abdominal Wall Surgery: A Systematic Review and Meta-analysis. World J Surg. 2021 Oct;45(10):3080-3091.
22. Tansawet A, Numthavaj P, Techapongsatorn S et al. Mesh position for hernia prophylaxis after midline laparotomy: A systematic review and network meta-analysis of randomized clinical trials. Int J Surg 2020 Nov:83:144-151
23. Deerenberg EB, Harlaar JJ, Steyerberg EW et al. Small bites versus large bites for closure of abdominal midline incisions (STITCH): a double-blind, multicentre, randomised controlled trial. Lancet 2015 Sep 26;386(10000):1254-1260
24. Mäkäräinen E, Tolonen M, Sallinen V et al. Prophylactic retrorectus mesh versus no mesh in midline emergency laparotomy closure for prevention of incisional hermia (PREEMER): study protocol for a multicentre, double-blinded, randomized controlled trial. BJS Open 2022 Jan 6;6(1):zrab142

25. Heger P, FeiBt M, Krisam J et al. Hernia reduction following laparotomy using small stitch abdominal wall closure with and without mesh augmentation (the HULC trial): study protocol for a randomized controlled trial. Trials 2019 Dec 16;20(1):738
26. Ulutas ME, Sahin A, Simsek G et al. Does onlay mesh placement in emergency laparotomy prevent incisional hernia? A prospective randomized double-blind study. Hernia 2023 27:883-893
27. Argudo N, Pereira JA, Sancho JJ et al. Prophylactic synthetic mesh can be safely used to close emergency laparotomies, even in peritonitis. Surgery 2014 Nov;156(5):12381244
28. Caro-Tarrago A, Olona C, Millán M et al. Long-term results of a prospective randomized trial of midline laparotomy closure with onlay mesh. Hernia 2019 23:335340
29. Van den Dop LM, Sneiders D, Yurtkap Y et al. Prevention of incisional hernia with prophylactic onlay and sublay mesh reinforcement vs. Primary suture only in midline laparotomies (PRIMA): long-term outcomes of a multicentre, double-blind, randomised controlled trial. The Lancet regional health - Europe 2024;36:1000787
30. Basta M N, Kozak GM, Broach RB et al. Can We Predict Incisional Hernia? Development of a Surgery-specific Decision-Support Interface. Annals of Surgery. Sept 2019 270(3):p544-553
31. Lima H VG, Rasslan R, Novo F CF et al. Prevention of Fascial Deshiscence with Onlay Prophylactic Mesh in Emergency Laparotomy: A Randomized Clinical Trial. J Am Coll Surg. 2020 Jan;230(1):76-87
32. Deerenberg EB, Henriksen NA, Antoniou GA et al. Updated guideline for closure of abdominal wall incisions from the European and American Hernia Societies. BJS 2022 109:1239-1250