FIGURES **Laparoscopic Port Suturing Apparatus and Method**

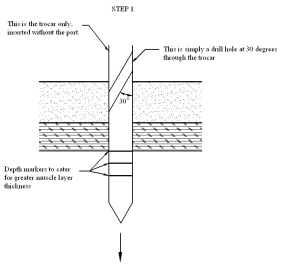
Single Suture in Non Obese Patients

Legend

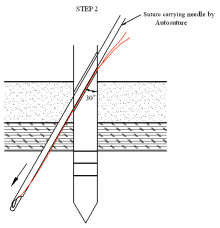
Suturing thread

Fat tissue

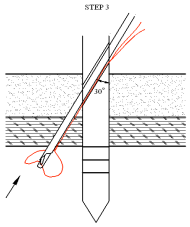
Muscle tissue



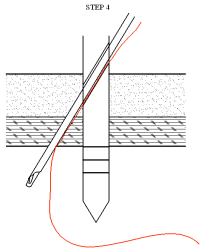
Trocar inserted into port opening to depth of markings (observed from telescope in another port)



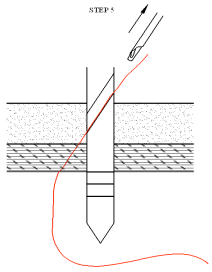
Needle carrying the suture pushed through trocar drill hole, muscle tissue and into abdominal cavity. Angle of needle relative to Trocar Say 30°



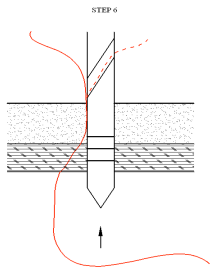
Needle withdrawn to create loop to be grabbed by forceps from different port.



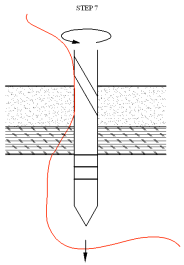
One end of suture pulled through into abdominal cavity with forceps.



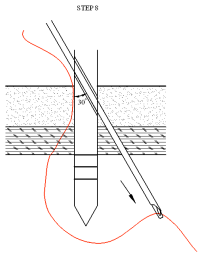
Needle withdrawn from trocar.



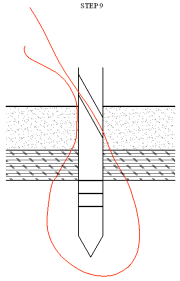
Trocar pulled outwards to reveal lower opening of drill hole so that suture can be removed from drill hole.



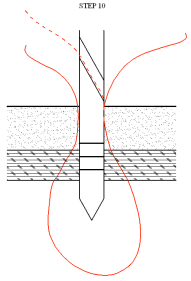
Trocar rotated about 180° (or smaller angles as appropriate for location of suture around port opening) and pushed back inwards to level of markings.



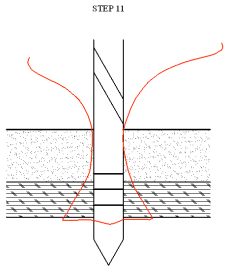
Needle reinserted into trocar drill hole, through muscle tissue and into abdominal cavity on other side of opening Suture grasped by suture carrying needle.



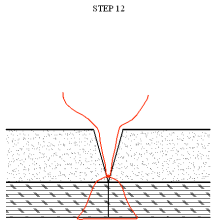
Needle withdrawn through tissues and trocar drill hole, bringing suture with it to surface.



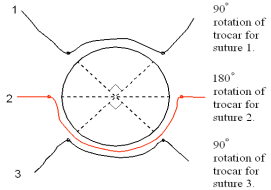
Trocar pulled outwards to reveal lower drill hole opening again so that suture can be removed from trocar drill hole.



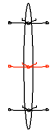
Suture safely snugged up around the trocar watched by the intra abdominal telescope. (For multiple individual or continuous sutures, trocar would be kept in until all sutures in place, with each suture tightened and snugged up against sides)



Both ends of suture pulled to tighten loop against the peritoneal lining and draw muscle tissue together, maintaining the pneumoperitoneum. Suture site can be inspected with the. telescope inside the abdomen Suture tied against outside of muscle layer.



Plan view of trocar rotations used to close a port site using three single sutures.



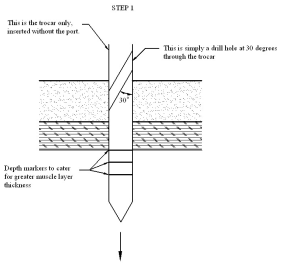
Muscle tissues drawn together by tying individual sutures after removal of the trocar.

Legend

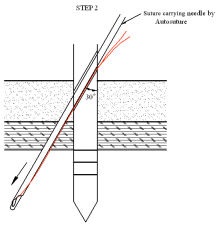
- Suturing thread
- Fat tissue
- Muscle tissue

Continuous Suture

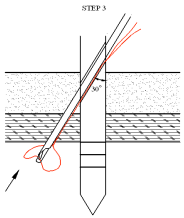
Stages 1-7 same as for Single Suture, stage 8 onwards demonstrate the quicker method of obtaining a continuous suture.



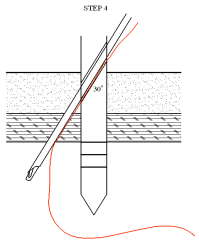
Trocar inserted into port opening to depth of markings (observed from telescope in another port)



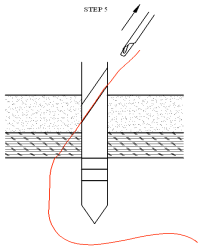
Needle carrying the suture pushed through trocar drill hole, muscle tissue and into abdominal cavity. Angle of needle relative to trocar say 30°.



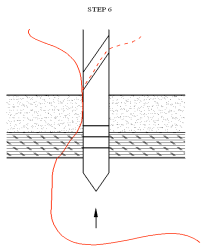
Needle withdrawn to create loop to be grabbed by forceps from different port.



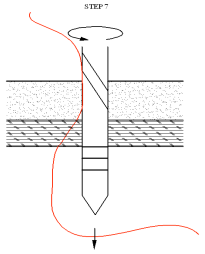
One end of suture pulled through into abdominal cavity with forceps.



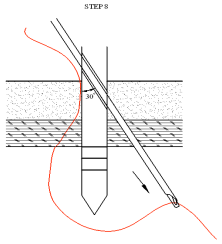
Needle withdrawn from trocar.



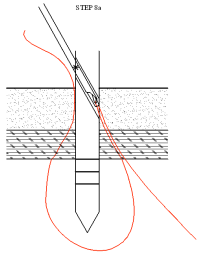
Trocar pulled outwards to reveal lower opening of drill hole so that suture can be removed from drill hole.



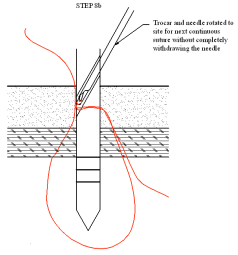
Trocar rotated about 180° (or smaller angles as appropriate for location of suture around port opening) and pushed back inwards to level of markings.



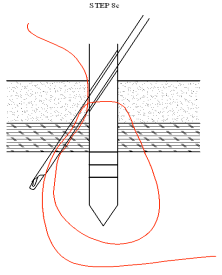
Needle inserted into trocar drill hole, through muscle tissue and into abdominal cavity on other side of opening.
Suture grasped by suture carrying needle.



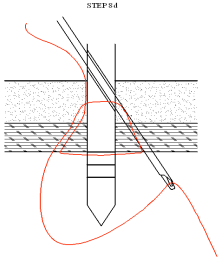
Needle withdrawn so that point is just within the trocar. (mark on needle at point of asterisk as in The Beeley Needle assists this manoeuvre)



Trocar rotated to site of next suture leaving suture still in situ.



Needle reinserted into abdominal cavity, suture released from needle and end pulled through with forceps into abdominal cavity.



Trocar rotated to final exit point of suture, needle reinserted and suture re-engaged, withdrawn and tied as for single suture.

Legend

Suturing thread

Fat tissue

Muscle tissue

Changes to Increase Accuracy and to Suture Port Sites in Obese Patients

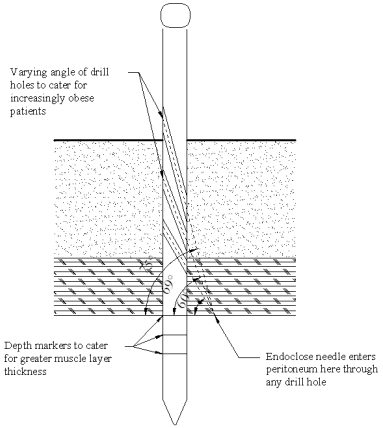


Figure 1
Side view

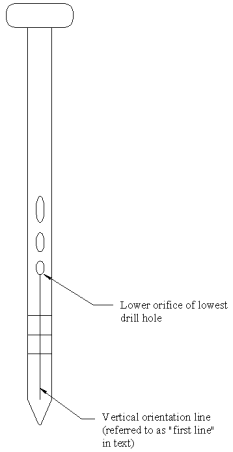


Figure 2
Anterior view

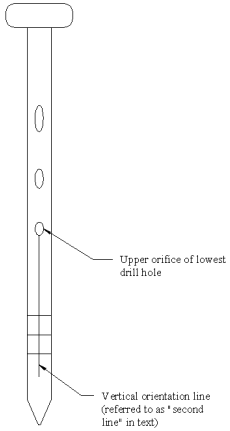
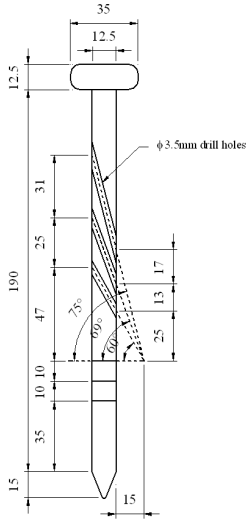


Figure 3
Posterior view



Dimensions of port suturing trocar prototype.

Ligating a Bleeding Epigastric Artery.
The PSSST can also be used to ligate a bleeding superior or inferior epigastric artery through which a port has been inadvertently passed.

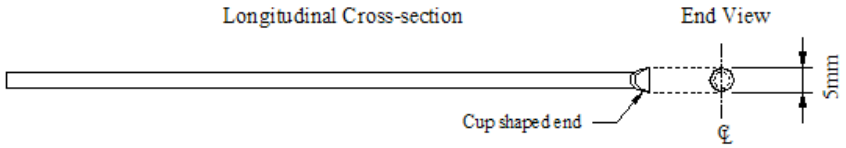
The PSSST is inserted through that port site and the dotted orientation line placed to one side of the bleeding point. The needle and suture is inserted into the abdominal cavity as above and the needle withdrawn. The trocar is revolved so the dotted line lies at the other side of the bleeding point and the needle reinserted to retrieve the end of the suture. The suture is now around the offending artery and when the knot is tied the bleeding will stop. The other end of the artery at the opposite side of the port site may require ligating similarly.

The Second Version of the PSSST is designed specifically for ligation of bleeding superior and inferior epigastric arteries damaged at the port site. The commonest port causing such damage is a 5mm port. Therefore the second version of the PSSST has a narrow distal end which lies in the rectus muscle layer but the suture carrying needle exits from the wider part of the PSSST superficial to the rectus sheath thus increasing the 'bite' of rectus muscle and artery included in the suture to be more sure of encompassing the bleeding artery.

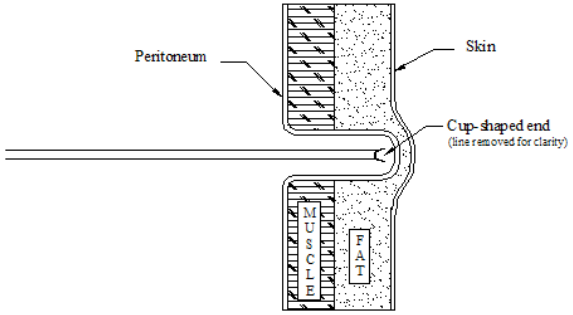
The drawing for this second version is in the download section 'PSSST Trocar production drawings'.

Repair of Established Port Site Hernias

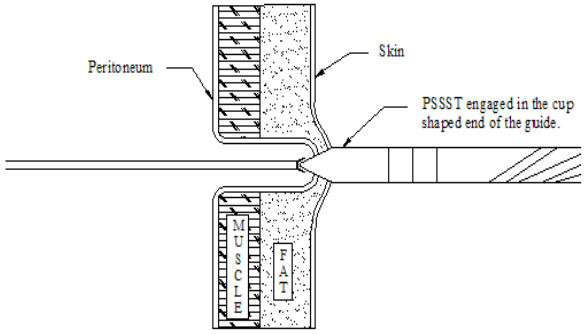
The Port Site Suture System Trocar (PSSST) can also be used for repairing an established port site hernia. This involves the production of an instrument that can pass down a 5mm port which is effectively a narrow rod with a cup shaped end to guide trocar into the abdominal cavity through the hernia site from within the peritoneal cavity. It is represented in the diagram below: Alternatively the end of a sucker could be used as the guide.



Having inserted the laparoscope well away from the port site hernia to be closed, a 5mm port is inserted into the abdomen as far away from the port site hernia as reasonably possible. The above instrument is inserted into the 5mm port and pushed into the hernia. The cup shaped end can then be felt through the abdominal wall.



An incision is made in the skin, fat and peritoneum to reveal the cup shaped end. The tip of the trocar is inserted into the cup shaped end.



It can now be pushed into the abdomen led by the instrument with the cup shaped End, pushing the hernial sack back into the abdomen. The trocar is then in place to suture the hernia site as described previously.