Endoscopic Feeding Techniques

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In the last 50 years, the use of endoscopic placement of feeding tubes has been used increasingly in clinical settings. After the use of traditional surgical gastrostomies and then later on nasogastric tubes, nowadays, predominantly percutaneous systems are used long term. Differentiated indication is imperative here. Even now, the individualized use of these procedures requires a high level of education. As of recently, endoscopic implants have also been used temporarily and also in cases of metabolic illnesses; these developments are also depicted here.

7.1 General Aspects

Oral food intake is the normal way of taking in food. Compared to artificial enteral feeding via tubes, this original way of taking in food offers significant benefits. Oral intake is comfortable, has a high social component and can, in the case of illness, e.g. swallowing disorders, be used therapeutically. Significant disadvantages of oral food intake, especially in patients with swallowing disorders are, at the same time, the reasons leading to the indication of tube feeding. The danger of aspiration, physical fatigue and especially the insufficient intake of substrates, even when using supplements, are significant. Prior to determining that a tube feeding is indicated, a feeding protocol about the intake of food and drink should always be created, so as to allow for ideal planning of therapy.

Introduction and Nomenclature of Tubes

Nowadays, different procedures of tube techniques are available, all of which differ significantly regarding the application of tubes and administration of substrates.

Basically, we must differentiate between tubes introduced through preformed stomas (e.g. nose) and percutaneously introduced tubes. The tubes are primarily named after the site of introduction into the body (nasal, gastric, enteral [jejunal, duodenal] (Fig. 7.1). A particular case is the endoscopically introduced percutaneous endoscopic caecostomy (PEC), which will be explained more in detail later on as well as surgically introduced tubes.

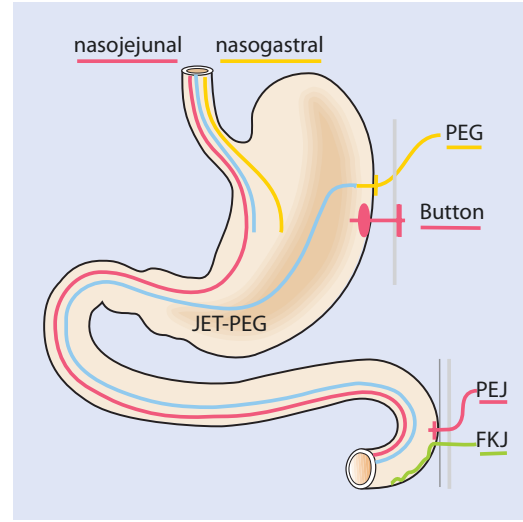

Fig. 7.1 Localization of feeding tubes at the upper GI tract (*Jet-PEG* PEG with jejunal port)

Tubes' nomenclature:
Tubes to be inserted manually:
Nasogastric tubes:
- Nasogastric

Tubes to be inserted endoscopically:
Nasal tubes:
- Jejunal tubes
- Combination tubes (tubes with multiple ports)

Percutaneous tubes – gastric/jejunal:
1. Primary techniques:
   - PEG: percutaneous endoscopic gastrostomy
   - PEG with jejunal port: «jejunal tube through PEG» = PEG + internal catheter
   - PEJ: percutaneous endoscopic jejunostomy (also «EPJ»)
2. Secondary techniques:
   - Button
   - Gastrotube

Percutaneous tubes – colon:
- PEC: percutaneous endoscopic colostomy/caecostomy

Tubes to be inserted surgically:
- FNCJ: fine-needle catheter jejunostomy

Ethical-Legal Aspects Regarding Tube Feeding

The primary objective of nutritional therapy is to maintain the patient's nutritional state or to improve it, thus positively influencing the patient's prognosis regarding his illness. Nutrition used to be an instrument of basic care, but in the meantime, it has developed into a highly efficient instrument for medical therapy and prevention and has become part of a modern and multimodal therapy concept (e.g. intensive therapy, oncological therapy, paediatrics, etc.). In addition to tube-specific indications, which are explained in the individual sections, it is now part of the physician's skills to develop a patient-dependent and targeted strategy under medical and ethical aspects, together with the care personal, the relatives and others involved. The type of patients treated ranges from a child in intensive care to the geriatric patient suffering from dementia at the end of his life.

Generally valid procedures cannot be determined. The legal provisions (living will, guardianship, possibly associated with the involvement of court, if needed) as well as the basics of palliative care and the involvement of an ethics consultation at the hospital (Oehmichen et al. 2013) should be taken into consideration.

7.2 Transnasal Tubes

Transnasal tubes are used when tube feeding is only performed for a short period of time (<4 weeks) or when the duration of feeding remains unclear and the definitive decision about the further procedure is still waited on (e.g. after a stroke with dysphagia and tendency of improving quickly or in intensive care patients) (Bernhardt 2007). The area of use varies significantly, and there are a number of tube sizes available for children and adults (▶ Sect. 2.1). Currently, only tubes made of polyurethane or silicone are used (Bernhardt 2007).

Nasogastric or nasojejunal tubes are used for brief (up to 4 weeks) enteral feeding.

Nowadays, we differentiate between three types of tubes (◘ Fig. 7.1).

Nasogastric Tube Various types of tubes are available; they differ in their outside diameter, length and the number of ports. They can be placed without the assistance of instruments, endoscopically or radiologically and/or a combination of both procedures.

Nasointestinal Tube This tube has one port only and is the simplest type of jejunal tube. Usually, the tube can be inserted under radiological or endoscopic control down into the upper jejunum. For the latter technique, diameters of 8.5 CH are available, through which only nutritional solution containing no fibre can be applied.

Combined Tube (Gastric and Jejunal Port) Usually, two-port tubes are used. The second port ends in the stomach, as is the case in the gastric tube, and serves for decompression of the stomach. Three-port tubes are also available, which are a combination of the two-port tube with an additional possibility for ventilating the stomach and an intestinal port.

Indications and Contraindications

Gastric tubes are usually used for the isolated and temporary deviation of secretion from the upper gastrointestinal tract, especially of the stomach. Here, peri- and postinterventional motility disorders, e.g. after interventions at the upper abdomen, must be named. In the case of a st. p. (partial) removal of the stomach, jejunal feeding via one-port tube is preferred; it is, e.g. necessary, when an early enteral feeding is planned, but the stomach's motility has not yet returned. One-port tubes are used for short-term enteral feeding (up to a max. of 4 weeks) or when a PEG is contraindicated (▶ Sect. 3). One benefit of two-port gastric tubes is that the stomach can be actively decompressed through the port inserted into the stomach, while the other port is available for the administration of nutrition or for removing secretions. This prevents the mucous membranes from adhering.

Tubes with multiple ports, with a gastric port and a jejunal port, can be used for decompression of the stomach as well as of the upper jejunum, as you would be able to with a one-port gastric tube. At the same time, jejunal feeding is possible or liquid medication can be administered. This is particularly indicated after surgery at disrupted increase of feeding or during long-term intensive therapy.

Further indications include the bridging of oesophagogastric, oesophagojejunal or gastrojejunal anastomoses and insufficiencies of anastomoses

or patients with motility disorders of the stomach caused by diabetes mellitus, neurosurgical interventions or peritoneal carcinomatosis. In these cases, tubes with multiple ports can serve to relieve pressure in the area of the anastomosis but predominantly serve early enteral postoperative feeding.

For tube insertion, the same indications and contraindications apply as for gastroscopy. Passing through anastomoses must be discussed with the surgeon prior to the intervention, since it might lead to increased stress on the anastomosis. Usually, tubes are inserted without problems; the risk of an endoscopic passage is often overestimated.

In cases of injuries to the face or skull, the therapeutic options have to be checked from case to case, since particularly in the case of tubes with multiple ports, a nasal access should be used.

Preparation of Patient

The patient's preparation also mostly corresponds to that of a routine gastroscopy. Prior to placing the tube, the patient and/or the relatives should be informed about the measure, which should also include subsequent nutritional therapy. In case of a nasal tube, the upper gastrointestinal tract must be freely passable.

For jejunal tubes, the patient must be prepared as he would be for an endoscopy. Intensive care patients are usually already sedated and ventilated. For a patient who is awake, analgosedation is essential for the endoscopic insertion of a tube.

Personnel-Related Requirements

Nasogastric tubes are usually inserted by trained nursing staff. The tube is often also inserted during surgery, during anaesthesia.

During an endoscopy, at least one endoscopy nurse and one physician must be present. The physicians must be experienced in endoscopy and in the use of the application technique required, since, depending on the site, a modification might be necessary. The measure should be planned in advance by the treating physician.

Instrument-Related Requirements

Usually, little is required of instruments. Tube-grasping forceps are practicable for grabbing the tubes. Ideally, devices with larger working canals (greater than 3 mm) are used. An endoscopy unit (possibly with mobile use in intensive care) must be present; additionally, the possibility of monitoring must also be available, if it is not an intensive care patient.

The preparation of the respective types of tubes will be depicted in the following sections.

7.2.1 Nasogastric Tubes

Instrument-Related Requirements

The following items are required: tube; lubricant for the mandrin, if needed; a stethoscope; irrigation syringe; bandage set; local anaesthetic; and a collection bag.

Practical Course

A number of tube sizes are available for children and adults (diameter 6.5–15 CH, length 40–60 cm for children, 100–130 cm for adults). PVC tubes should not be used anymore. Due to their high biocompatibility, the decreased feeling of foreign body and the good long-term stability, newer tubes made of polyurethane plastics and silicone rubber are also used for long-term nasal and percutaneous use.

The selection of tubes depends on various parameters. The tube's diameter should be as small as possible to allow for the highest possible comfort of the patient. At the same time, however, if the diameter is too small, application of nutrition and/or medication might become more difficult and can lead to an occlusion of the tube. For children, usually tubes with a diameter of 8 CH are used, whereas for adults, tubes with a diameter of 15 CH are usually used. For children, the tube should be 50–60 cm long, and for adults, however, it should be between 100 and 120 cm.

Sometimes, it can be of use to determine the respective length of the tube required ahead of time. For this, the distance from the earlobe to the tip of the nose (usually 10 cm) must be added to the distance of the nose to the epigastrium (usually 40–50 cm). This distance can then be marked on the tube to avoid a curling of the tube once it is placed in the stomach.

After having cleaned the nasal passages and selected the larger nostril, the nasal entry is anaesthetized with a local anaesthetic gel or spray. The patient is positioned in an upright or semi-upright position. Initially, the tube is advanced for about 10 cm at the bottom of the inferior nasal meatus.

Then, the head is tilted forwards and the patient is asked to actively swallow while, at the same time, advancing the tube. If the patient is coughing or if there is resistance, the tube must be retracted, and another attempt must be made. In case of a good passage, advance the tube in gastric direction, and after having determined the position, usually by blowing in air through auscultation (alternative methods include determination of pH or x-rays), the tube is then secured to the nose.

Complications and Management of the Same

Great advantages of the nasogastric tube placement include the bedside placement and simple technique, which is noninvasive and available everywhere. Compared to the percutaneous techniques, no parallel techniques are required (Bernhardt 2007).

Despite all precautions, the placement of a nasogastric tube is also associated with acute and chronic risks. The placement of tubes can lead to nosebleed and injuries to the afferent ways as well as to a refractory bradycardia up to asystole. In the long run, repeated tube dislocations and lesions of the afferent paths (nose, oropharynx, oesophagus, stomach) limit the use of these types of tube systems. In addition, swallowing rehabilitation is also more difficult when a tube is inserted. Clinically relevant factors include the reduced application of enteral nutrition compared to percutaneous tubes, caused by dislocation, as well as the latent danger of aspiration. This can lead to a vital threat to patients.

Standardized Aftercare After the Placement of Tubes

Aftercare generally corresponds to the general care guidelines; food can be introduced immediately.

7.2.2 Nasojejunal Tubes

Instrument-Related Requirements

The following are required: prepared tube, possibly lubricant for the mandrin, a bandage set, a gastroscope (with a large lumen) and grasping forceps. In the case of many manufacturers, preparation of the tube includes filling the lumen with silicone oil or water, which significantly facilitates the later removal of the mandrin.

Figs. 7.2, 7.3 and 7.4 show tubes with one, two and three ports.

Fig. 7.2 One-port tube (Courtesy of company Fresenius)

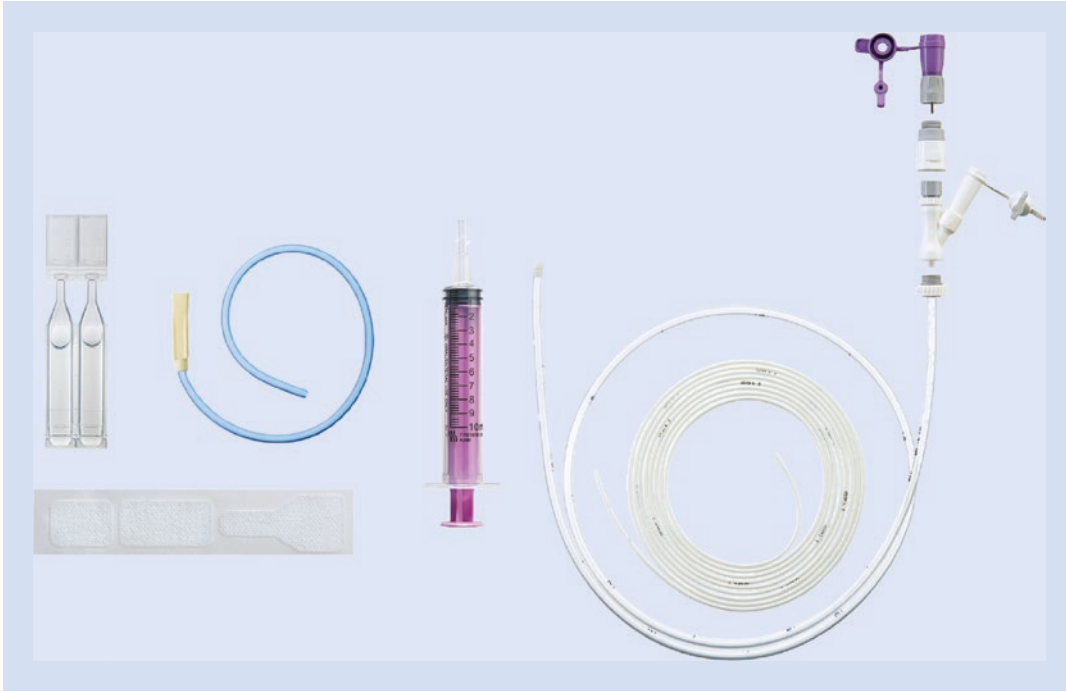

Fig. 7.3 Two-port tube (Easy In) (Courtesy of company Fresenius)

Fig. 7.4 Three-port tube Trelumina (Courtesy of company Fresenius)

A deciding factor for the successful clinical use of nasointestinal tubes is the application technique that must guarantee the secure and permanent position of the tube in the area distal of the duodenojejunal flexure or, in rare cases, in the distal duodenum (Külling et al. 2000).

Techniques of jejunal tube placement:

- TTS («through the scope»)
- OTW («over the wire»)
- BTS («beneath the scope»)

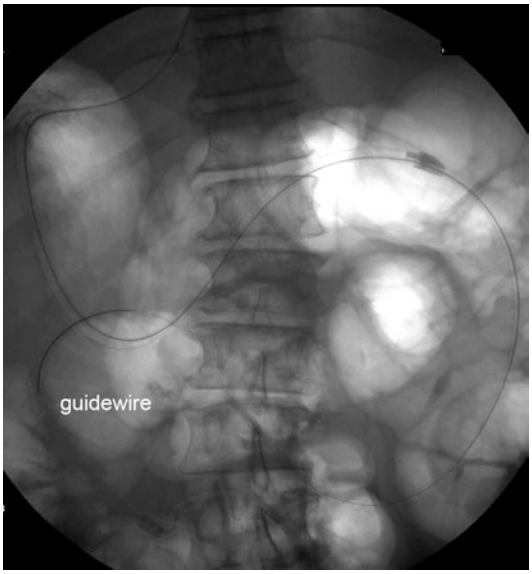

Fig. 7.5 Insertion of a Trelumina tube over a guidewire (OTW technique)

The simplest method is the «through the scope» technique (TTS), which includes the direct insertion of a thin tube directly into the jejunum through a widely guided endoscope, which is then left in place when removing the device. During the final naso-oral deviation, it must be ensured that the tube is placed straight in the hypopharynx. A disadvantage of this method is that even when a device with a maximum-sized working canal is used, only tubes with one port and a small diameter can be used.

In the case of the «over-the-wire» (OTW) technique, a guidewire (e.g. 0.035″ Jagwire Boston Scientific) is endoscopically inserted into the small intestine and remains in place when removing the endoscope. Through this inserted wire, which had been deviated nasally, a tube is placed (Fig. 7.5) (see technique of nasobiliary tube, ▶ Chap. 4).

This technique can be used for one-port (nasojejunal) as well as for tubes with several ports, but usually requires a radiological checking of the position prior to applying nutrition.

Especially in the case of tubes with several ports, a radiological control or having marked the tube with a colour code is helpful.

Very often, the insertion technique «beneath the scope» (BTS) is used. It includes grabbing the distal end of the nasally inserted tube with special forceps endoscopic-gastrically, which is then guided in intestinal direction using the device. If further endoscopy is not possible anymore, the forceps with the affixed tube are advanced as much as possible and then remain in situ while the device is retracted. Once the (diagnostic) endoscope is positioned in the stomach, the forceps are loosened and then slowly moved back into the device. This technique is generally helpful when inserting intestinal tubes, such as a jejunal tube via PEG.

If the tube is dislocated in proximal direction, the tube can then be advanced again using the grasping forceps. When placing tubes with several ports, it must be ensured that the gastric tube opening is not placed transpylorically. Sometimes, this endoscopic procedure is work intense and also requires special skills of the person performing the procedure. An advantage includes the good control of the tube's position through direct visual control.

The BTS procedure is of the same value as the OTW procedure described before; the method being used is up to the person performing the procedure.

Due to the comfortable technique, two procedures of inserting a tube are usually combined. In the case of the two-port tube Easy In, the jejunal tube is initially placed using the TTS technique. The jejunal part of the tube is then deviated with a deviation tube as would be the case when inserting a nasobiliary tube (▶ Chap. 4). Afterwards, the inserted tube is used as a splint for the gastric port, which is inserted through the same into the stomach, nasally. An alternative procedure would include the nasal insertion of the three-port tube into the stomach, as would be the case with a gastric tube, and then placed into the jejunum using the BTS technique.

Complications and Management of the Same

Acute complications during the insertion procedure are rare. An inexperienced endoscopic physician might have difficulties with the placement, which may sometimes be technically even impossible for him. Time requirements vary significantly, but usually it takes an experienced physician 15 min.

The following applies to all intestinal procedures: The small diameter of the tube promotes

occlusion, especially when applying medication. In addition to the problems associated with nasal tubes, which are identified above, intestinal tubes carry the potential risk of dislocation with the consecutive risk of aspiration. This is particularly the case when there is no deep intestinal placement.

Changing from the mouth into the nose also carries the risk of dislocation.

Tubes inserted for a longer period of time carry the risk of erosions and ulcerations at the distal oesophagus and stomach. For these reasons, these should not be inserted for more than 2 weeks; then instead, a PEG is placed. In the end, nasointestinal tubes with one or more ports should only be used for short periods of time, in selected patients. Deciding factors are experience and success of primary placement (Dormann and Deppe 2002).

7.3 Percutaneous Endoscopic Gastroscopy

Since the initial description through Gauderer and Ponsky in 1980, the percutaneous endoscopic gastrostomy (PEG) is now widely spread worldwide due to the technically simple and secure placement options and due to the high acceptance by patients. In the United States, about 216,000 PEG tubes are now newly inserted annually (210,000 adults, 6000 children). The annual growth rate is in the double digits. There are no reliable numbers for Germany, but based on epidemiology, we assume that in Germany, there must be about 130,000 PEGS newly inserted annually.

Indications

Please view Table 7.1 regarding the indications for a percutaneous tube. As is the case in every medicamentous therapy, each case must be assessed carefully to ensure that this type of feeding procedure is a reasonable therapeutic option. This especially applies to patients suffering from dementia.

Table 7.1 Significant indications for the insertion of a PEG

Neurological illnesses	Swallowing disorders, e.g. due to insult, cerebral trauma or surgery, atrophic lateral sclerosis (ALS), brain tumours, multiple sclerosis, dementia (?)
Oncological illnesses	Swallowing disorders, e.g. in cases of stenosing tumours in the oropharynx and oesophagus Tumour cachexia due to inadequate oral food intake Mucositis, diarrhoea
Other indications	Traumas of the facial skull or surgery Chronic obstructive pulmonary illnesses with severe cachexia Severe absorption disorders, also short bowel syndrome Mucoviscidosis Systemic illnesses (collagenoses, etc.) Palliative decompression, retention stomach Longer enteral feeding at intensive care

Contraindications

The absolute contraindications are clinically significant.

Absolute contraindications for insertion of a PEG:

- Endoscopy cannot be performed, e.g. in the case of absolute passage obstruction
- Severe coagulation disorders (Quick <50%, PTT >45 s, platelets <50,000/µl)
- Pylorus stenosis, e.g. endoscopic local findings (large ulcers, severe erosive gastritis, extensive tumour infiltration of the stomach)
- General contraindications for enteral feeding, e.g. peritonitis, ileus
- Acute abdominal illnesses, e.g. intraabdominal infections, pancreatitis, peritonitis
- Anorexia nervosa
- Severe psychosis

The relative contraindications are predominantly dependent on the examiner's experience and should be checked strictly by the beginner.

Relative contraindications for PEG insertion:

- Chemotherapy, acute infections, sepsis
- No diaphanoscopy
- Ascites, peritoneal carcinomatosis
- Ulcer in the area of the puncture
- (Partial) stomach removal (select jejunal tube technique)
- Anatomical particularities (e.g. hernias of the abdominal wall)
- Portal hypertension, abdominal wall varices
- Peritoneal carcinomatosis
- Ventriculoperitoneal shunt
- Peritoneal dialysis
- Ileus/intestinal obstruction
- Gastrointestinal fistulas
- Infaust prognosis (survival time <4 weeks)

If the patient is suffering from an acute infection or sepsis, enteral feeding should be guaranteed by a nasal tube until the infection has consolidated. In the case of an acute infection and prior to and/or after chemotherapy with leucocyte nadir, the elective insertion of a PEG should be postponed and performed at a more beneficial time. If that is not possible, a periinterventional antibiotic prophylaxis should be performed for a few days, and/or ongoing antibiotic therapy should be continued.

Nowadays, a missing diaphanoscopy is not considered a contraindication anymore. If an impression of the abdominal wall leads to a good protrusion of the stomach's wall and if a good passage into the stomach can be achieved with a thin needle during the trial puncture, a PEG can also be inserted into these patients, provided the physician has some experience (Ponsky 1996). Patients proven to be suffering from disorders affecting the emptying of the stomach should primarily receive a jejunal tube. If that is not possible, a PEG can be initially inserted, which can then, over time, be increased in length in jejunal direction (▶ Sect. 4). Larger amounts of ascites or a peritoneal carcinomatosis can prevent the adhering of the stomach to the abdominal wall and pose a contraindication. If, periinterventionally, insertion of a long-term ascites drain is guaranteed, a PEG can also be inserted in these patients using a direct puncture procedure and gastropexy (▶ Sect. 3.2). In this case, however, the tube remains taught for a prolonged period of time, so as to ensure adherence of the anterior wall of the stomach to the anterior abdominal wall.

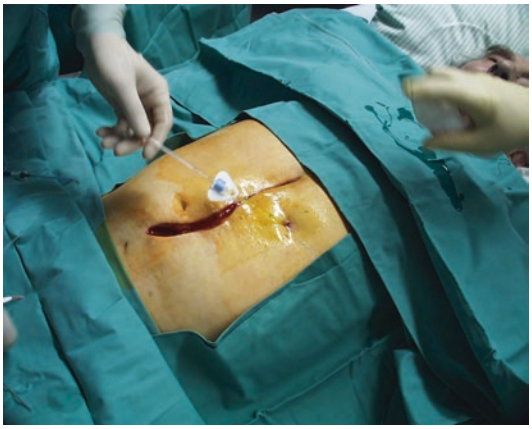

Fig. 7.6 Postoperative insertion of a PEG

An active ulcer is only a problem if the ulcer is located directly in the area of the puncture site at the anterior wall of the stomach or at the pyloric orifice. In these cases, ulcer therapy should take place first, and the tube should be inserted later on. An alternative would be using the jejunal tube technique. Placement of a PEG may also be impossible due to st. p. surgeries, especially when stomach-removing procedures were selected and when the remaining residual stomach is too small or not present (Fig. 7.6).

If placement is not possible, a jejunal tube insertion is usually possible without problems in these cases. Sporadically, larger hernias in the upper abdomen can make placing a tube more difficult. In cases of portal hypertension leading to oesophageal varices and hypertensive gastropathy, placement of a PEG can sometimes be impossible due to large vessel convolutes or severe coagulation disorders. In patients with a ventriculoperitoneal shunt or peritoneal dialysis catheters, making a decision is more difficult. For both cases, there are reports of successful placements of PEGs. This intervention should then, however, be performed in experienced centres to avoid damaging the catheter and infectious complications. A simultaneous implantation of a ventriculoperitoneal shunt must be avoided.

Anorexia nervosa and psychoses are still generally clear contraindications. In cases of a terminal illness, indication is only given under the palliative aspect of draining the stomach.

Preparation of the Patient

Preparation of the patient should be a standardized procedure at every hospital. Upon arriving at endoscopy, a checklist should be used to ensure the presence of everything required, before the patient is brought to the exam room. Patients receiving a PEG should be scheduled early to allow for discovering possible complications during the course of the day.

Preparing a patient for insertion of a PEG:

- Information: >24 h prior to intervention, signed legally valid informed consent, give out copy to the patient/guardian (**please note**: a guardian is required in cases where patient is not able to provide consent).
- Patient needs to remain fasting (at least 8 h), in case of a retention stomach up to 24 h.
- Stable venous access.
- Regular administration of antibiotic prophylaxis (e.g. cephalosporin first generation) 30 min prior to the intervention.
- Facultative: disinfection of the mouth/pharynx.
- If there is hair, shorten hair with hair cutter, if needed.
- Rule out contraindications.
- Current coagulation status: Quick >50%, PTT <40 s, platelets >50,000/mm^3).
- During endoscopy, positioning of the patient in supine position with the head sideways.
- Fixation of the hands using Velcro strips, if needed.

Personnel-Related Requirements

The following must be present during the examination: at least one person for sedation (usually a nurse experienced with sedation), an endoscopy nurse and two physicians for endoscopy and puncture. The physicians must be experienced in endoscopy and in the use of the various tube techniques, since, occasionally, depending on the site, changing of the application technique might be required.

Instrument-Related Requirements

- As is the case in every interventional endoscopy, continuous measuring of O_2 saturation (pulse oximetry), taking of the blood pressure with documentation and, in patients starting at ASA III, an EKG deviation are required.
- Additionally, a sterile table must be prepared especially for this examination, containing the following:
  - PEG set (PEG tube, scalpel, puncture cannula made of steel with a plastic sheath, external fixation plate, tubing clamp, application adapter (Fig. 7.7))
  - Incise drape
  - Gauze pads
  - Dressing set with y-gauze pad
  - Syringe 10 ml with local anaesthetic and puncture needle size 1
- For sedation, prepare midazolam (5 mg syringe) and propofol (200 mg syringe).
- Prepare standard gastroscope.
- Surgical standard with sterile gloves, clamp or tweezers for washing off and solution for skin disinfection.

Practical Development

After disinfection of the abdomen, intubation of the endoscope and ruling out of relevant illnesses of the proximal gastrointestinal tract (such as ulcer, pylorus stenosis, etc.). In a darkened room, after extensive insufflation of air in the area of the anterior wall of the stomach, in oral direction of the angulus fold, searching for a diaphanoscopy. Required is the following: a circumscribed, clear and clearly identifiable diaphany with clearly positive fingerprint and no problems with reproduction (Fig. 7.8). It might be helpful to position the patient flat or with exposition of the lower thoracic aperture, so as to allow a secure puncture of the stomach. The examiner must be aware of the insufflation changing the stomach's topography and that the most secure puncture site is slightly left to the epigastrium, yet at least 2 cm from the left coastal arch.

7.3.1 Thread Pull-Through Method

After local anaesthesia of the abdominal wall, puncture of the stomach's lumen. The puncture site is located in the middle area of the left upper abdominal quadrant. Especially in the case of insecurities regarding the puncture, aspiration is possible while advancing the local anaesthesia

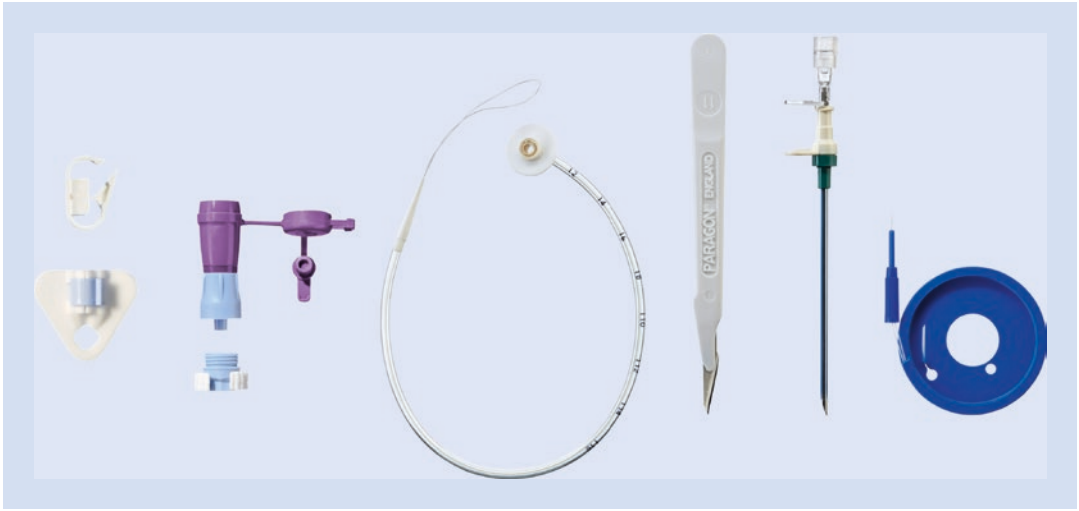

Fig. 7.7 PEG set CH 15 Freka (Courtesy of company Fresenius)

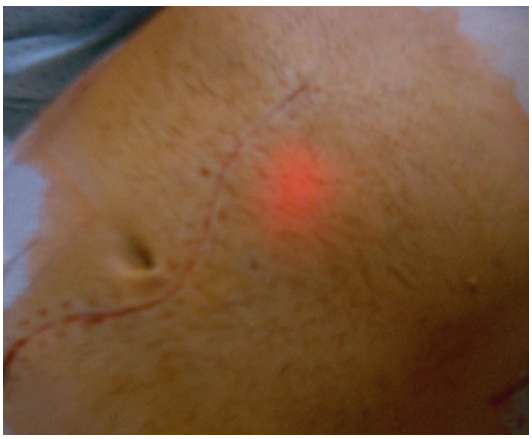

Fig. 7.8 Diaphanoscopy prior to insertion of PEG

needle. If blood or air is aspirated without the tip of the needle being visible in the stomach's lumen, the puncture site must be changed (negative needle aspiration test) (Fig. 7.9a). The puncture needle is then directed into the stomach to determine the length and direction of the future stoma canal. Afterwards, deep puncture incision is done, about 1 cm in width, and puncture cannula of the regular set is introduced (Fig. 7.9b). After retreating the puncture needle, the introductory sheath remains in the stomach. Through the same then, introduction of the pulling thread is done, which is grabbed using forceps and then pulled in oral direction (Fig. 7.9c, d). The PEG tube is attached to the end of this thread and pulled through the oropharynx into the stomach (Fig. 7.9e). The base of the tongue is protected by inserting one finger between the thread and the actual tongue. The thread is pulled with caution and continuously. At the end of the intervention, the internal fixation plate must be located at the anterior wall of the stomach. An endoscopic control is usually not required. In case of stenoses of the passage way, the internal fixation plate can be cut crosswise so as to facilitate the passage. Afterwards, application of the external fixation plate and application of a standardized dressing to the wound are done. The tube must be affixed using light pressure to ensure adhesion between the stomach and the abdominal wall. After 48 hours, loosening of the tube, turning of the same in the stoma canal and slight pulling prior to applying another dressing.

7.3.2 Direct Puncture Technique mod. According to Dormann

- **Indications/Contraindications**

From technical standpoint, the procedure deviating from the direct puncture technique (insertion of the tube from outside to inside) is better suited for the patients, since the fixation plate is not passing through the oropharynx (Russel et al. 1984). It is primarily indicated for the patient groups described below who benefit from this percutaneous access.

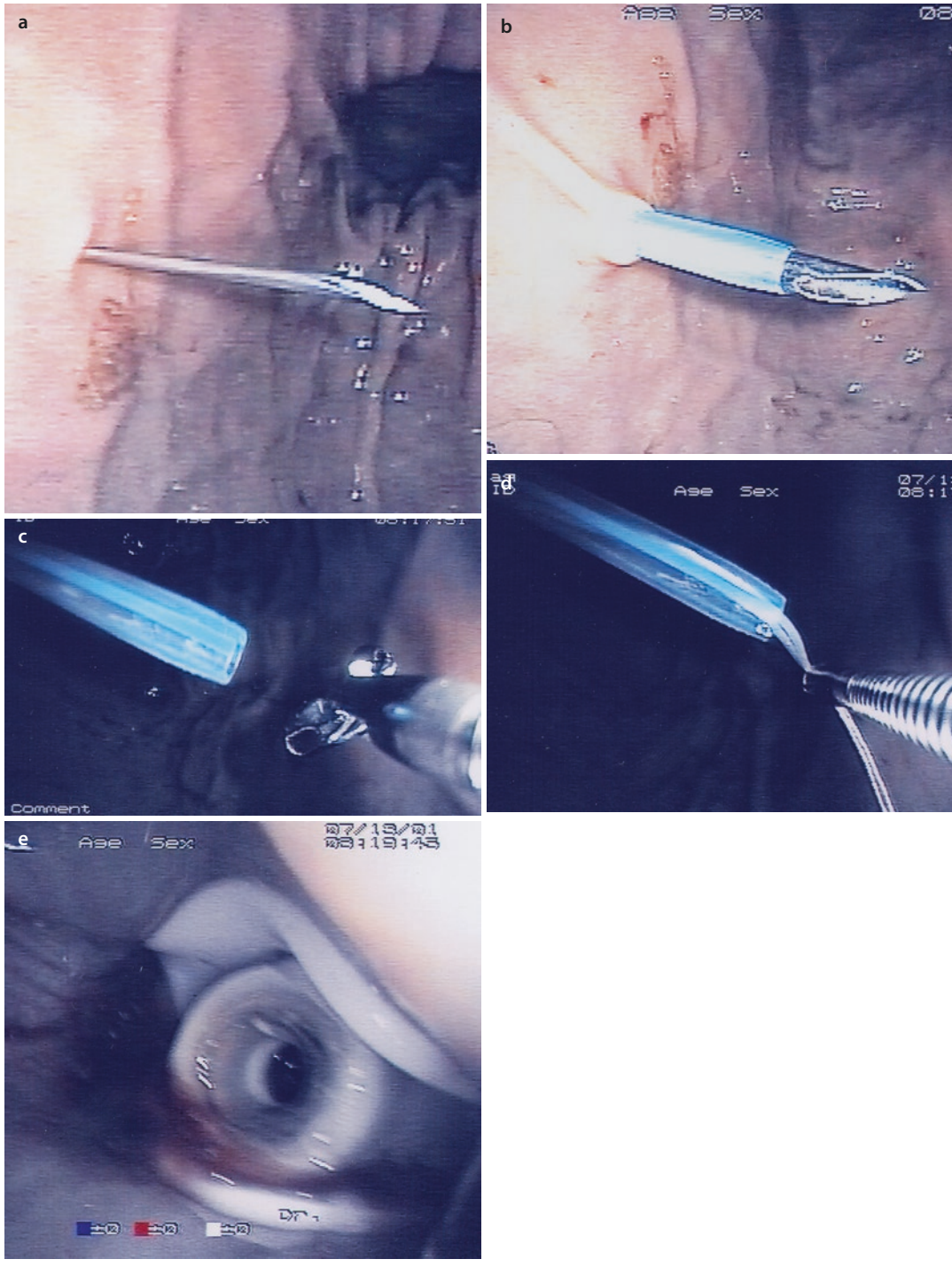

Fig. 7.9 Placement of a PEG via pull-through method of thread: **a** prepuncture, **b** cannula in place, **c** *cannula* with introduced forceps, **d** grasping forceps with thread grabbed, **e** temporary internal fixation plate through the oesophagus

This procedure exhibits the same contraindications as the pull-through PEG.

Patients with indication for direct puncture PEG:

- Primary nasal endoscopy
- High-degree stenoses in the oesophagus/oropharynx
- Danger of spreading tumour through pull-through PEG, especially in cases of curative therapy intentions
- Perioperative PEG insertion for a short period of time
- Oropharyngeal contamination with MRSA
- PEG insertion with gastropexy necessary in case of development of ascites (malignant or hypoalbuminemia)

Preparation of Patient

Preparations are the same as for the pull-through PEG.

Due to the minimal costs and proven efficiency, antibiotic prophylaxis to reduce local infections is, however, necessary.

Instrument-Related Requirements

- As is the case in every interventional endoscopy, continuous measuring of O2 saturation (pulse oximetry), taking of the blood pressure with documentation and, in patients starting at ASA III, an EKG deviation, are required.
- Additionally, a sterile table must be prepared especially for this examination and must contain the following:
  - PEG set (currently only commercially available set Freka-Pexact with PEG tube, scalpel, puncture cannula made of steel with peel-off plastic sheath, exterior fixation plate, tubing clamp, application adapter, suture set, thread set) (Fig. 7.10)
  - Incise drape
  - Gauze pads
  - Dressing set with y-gauze pad
  - Syringe 10 ml with local anaesthetic and puncture needle size 1
  - Sterile gloves, clamp or tweezers for washing off and solution for skin disinfection
- For sedation: prepare midazolam (5 mg syringe) and propofol (200 mg syringe).
- Prepare stenosis gastroscope (outer diameter of about 5 mm).
- Surgical standard for application with sterile gloves.
- Have available a guidewire with hydrophilic tip, e.g. Jagwire (Boston Scientific), in case of high degrees of stenoses.
- If needed, fluoroscopy option with C-arch, if the endoscope can only be inserted after wire passage.
- Have readily available dilation balloons or bougies with a diameter of about 7 mm.

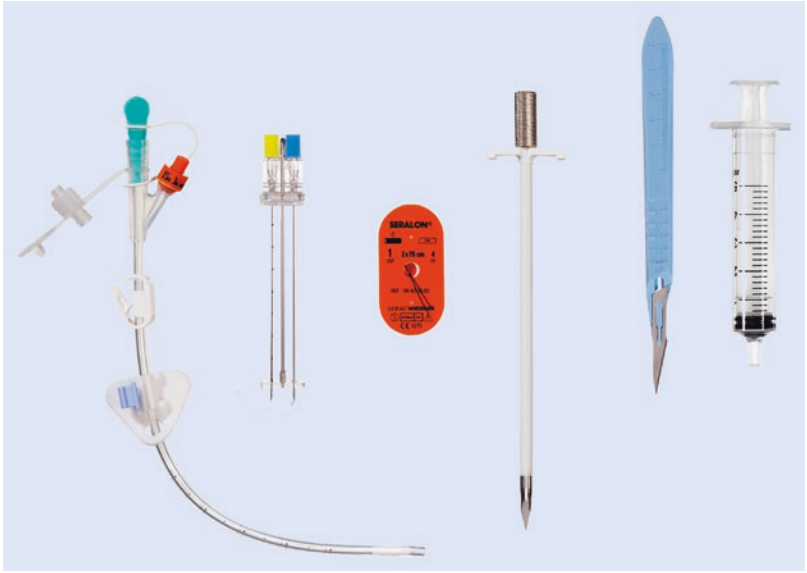

Fig. 7.10 Freka-Pexact set (Courtesy of company Fresenius)

Practical Course

Insertion of the direct puncture PEG depicted here using an example (Freka-Pexact) is a standardized procedure used in every patient (Fig. 7.11a–j). Gastroscopy is primarily performed through nasal or oral intubation. In cases of high degrees of stenoses, the guidewire (e.g. Jagwire, Boston Scientific, 0.035″) is initially guided through the stenosis, and the endoscope is then advanced under radiological control. After having ruled out a pylorus stenosis endoscopically and if there is evidence of the diaphanoscopy and/or positive needle aspiration test, administration of local anaesthesia will follow (10 ml xylocaine 1%). Under surgical conditions, the stomach is now fixed to the anterior abdominal wall via double-port gastropexy device. Once the gastropexy device is securely positioned intragastrically, the sling is opened, and the gastropexy thread is inserted; after fixation, the gastropexy device is removed, and a U-shaped suture is placed above the skin. A second gastropexy suture is placed 2 cm further. After the stab incision (width of the blade of a standard scalpel) between both gastropexies, the stomach is punctured using a trocar with a peel-off sheath. While doing this, a good endoscopic insufflation of air must be ensured so as to avoid injuries to the posterior wall of the stomach by the trocar. Additionally, the gastropexy threads can be used as retention threads of the abdominal wall, if the puncture turns out to be more difficult. Once a secure intragastric position is ensured, the balloon catheter is inserted through the sheath, blocked with 4 ml of 0.9% physiological saline solution, and finally, the endoscope is removed. Afterwards, the exterior fixation plate is fixed. In the end, the wound is disinfected and applied with a pathogen-free dressing (sterile plate and dressing).

Complications

We differentiate between slight and severe complications during the intervention, in the short-term follow-up up to 7 days and in the long run.

Complications During the Intervention

Disorders connected to the passage and pulling through the endoscopic access to the stomach can be more difficult due to stenoses but also due to the inserted metal stent with granulation tissue. An alternative procedure would be the direct puncture procedure. It includes the use of a wire-guided stenosis endoscope, possibly after dilation, or wire-guided dilation with a bougie. If needed, a radial cut can be made into the fixation plate, or it can be guided through the stenosis using grasping forceps (Figs. 7.12 and 7.13).

When pulling through, the sling might get caught up in the teeth, tongue, uvula and epiglottis, causing severe lesions. These complications can be avoided by guiding the thread using the finger inserted in the pharynx.

Puncture An incorrect puncture or loss of access predominantly occurs in badly sedated patients. If no bleeding develops, the intervention can be continued. Punctures of every organ have been described for cases of bad conditions. An inserted shunt can also pose a risk and should therefore be located prior to puncture (Fig. 7.14).

If, after surgery, the suspicion of an incorrectly performed puncture arises, cross-sectional imaging is required; simply and solely administering contrast agent via inserted PEG tube cannot answer the question regarding a possible injury to an organ along the tube.

Bleeding Bleeding is a rare (<0.01%) yet potentially severe complication. To reduce the risk of bleeding, a small depot with local anaesthetic should already be applied into the stomach's wall during the pre-puncture process, if needed, to achieve a local compression. In case of more severe bleedings, local haemostasis, e.g. with clip or injection, can be undertaken (Fig. 7.15); this is usually sufficient. During direct puncture, the patient can develop a severe bleeding during an incorrect puncture of the posterior wall of the stomach, and in those cases, a surgical intervention might be needed.

Tent Ceiling Phenomenon In the case of a tent ceiling phenomenon (Fig. 7.16), the mucous membranes of the stomach cannot be punctured when trying to insert the puncture needle, but instead, it is lifted as would the ceiling of a tent. An ideal insufflation of air to tighten up the abdominal wall reduces this phenomenon. To avoid this, the puncture should be performed using sudden movements. If that is not possible, the primary puncture needle can be affixed gastrically using the grasping forceps, and then the puncture can be performed, according to the technique of the PEJ (▶ Sect. 7.4).

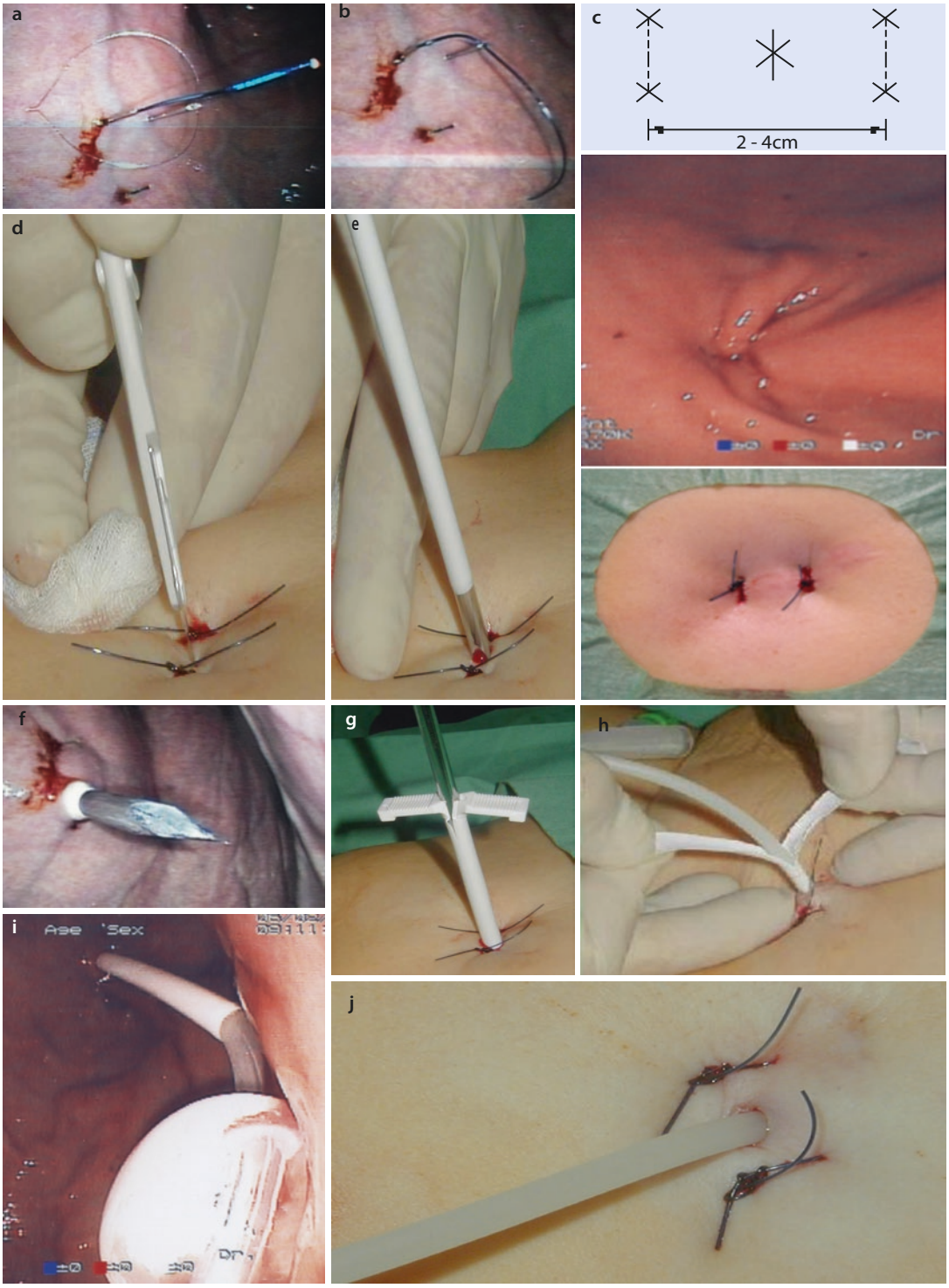

Fig. 7.11 Direct puncture technique for insertion of a PEG/PEJ: **a** gastropexy device in situ with opened sling, **b** grabbed suture thread, **c** double gastropexy from inside and outside with suture distance, **d** stab incision, **e** puncture with trocar, **f** trocar from gastric, **g** trocar with peel-off sheath, **h** peel-off of the sheath, **i** blocked balloon from the inside, **j** end of the procedure

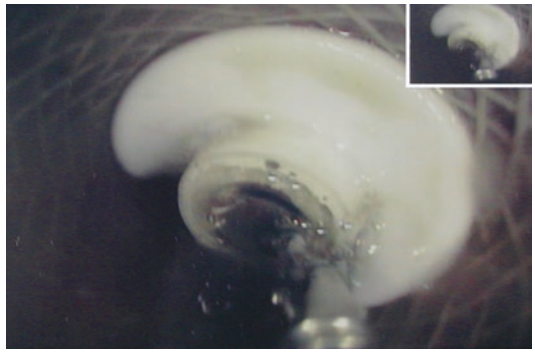

Fig. 7.12 Through the grasping forceps, the fixation plate leads to a self-expanding plastic stent (SEPS)

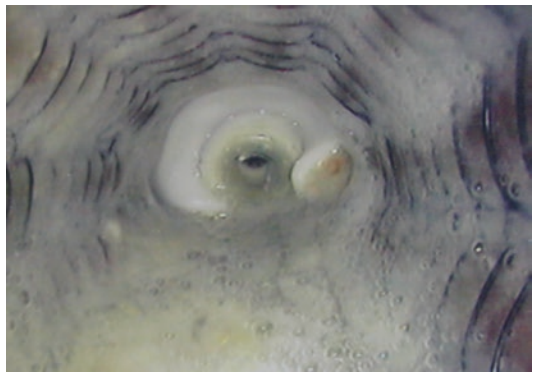

Fig. 7.13 Passage of PEG through self-expanding metal stent (SEMS)

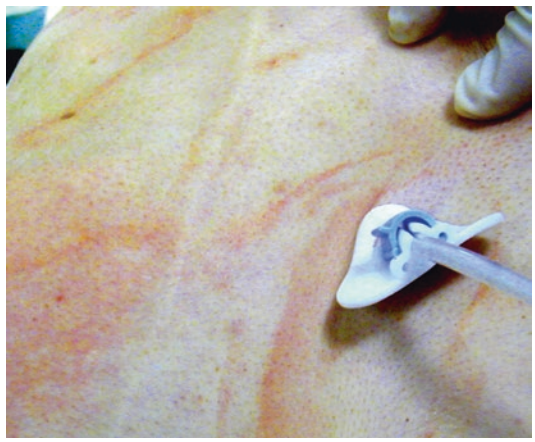

Fig. 7.14 Localization of a VP shunt

Pain About 30% of the patients develop pain after surgery, which is a reason to inspect the wound. A beginning peritonitis must be clinically ruled out. Initially, analgesics are used (e.g. tramadol). The patient should also be monitored.

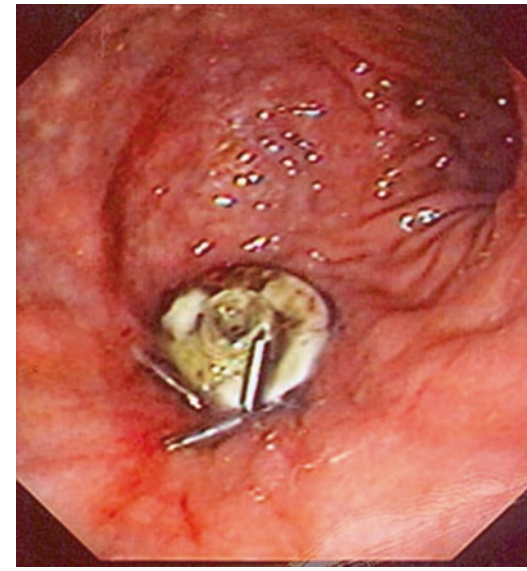

Fig. 7.15 Peristomal bleeding with clips

Fig. 7.16 Tent roof phenomenon

Pneumoperitoneum Often, a pneumoperitoneum also develops in cases of correctly inserted devices (CAT scans of the abdomen reveal that up to 50% of the patients are affected). There are usually no symptoms, and even if there are problems, it should not be a primary indication for a laparotomy.

Dermal Emphysema A dermal emphysema is a rarity and should be closely monitored.

Complications After the Intervention

Infections Within the first 7 days, local infections (Fig. 7.17) occur in about 30% of the interventions. The best predicative marker is the amount of secretion within the first 72 h. If the dressing is soaked more than three times daily during this timeframe, it must be assumed that

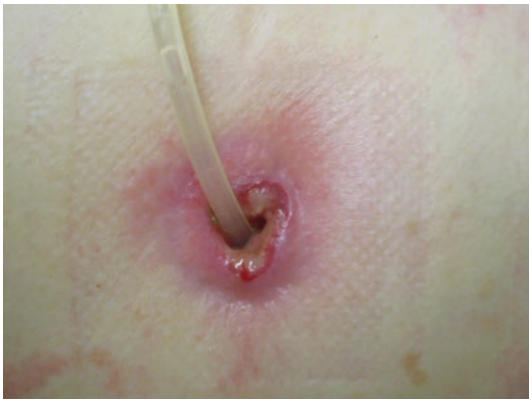

Fig. 7.17 Peristomal infection with granulation, secretion and development of pus

the patient developed an infection and that the stoma requires a more intense wound care. Severe complications usually include systemic infections such as aspiration pneumonia, peritonitis, fasciitis and local infections requiring surgical therapy. Aspirations can occur during the actual gastrostomy but also during the feeding phase. When inserting a feeding tube, this complication can be avoided through premedication, suitable positioning and permanent oral/pharyngeal suction. These severe complications always require systemic administration of antibiotics and can be reduced through preoperative prophylactic administration of antibiotics. Infections can also be observed in tubes that have been inserted for a longer period. If antibiotics and intensive wound care do not lead to success, the tube has to be removed in very rare cases and then inserted at another site (Fig. 7.18).

Inoculation Metastasis In patients with tumours in the oropharynx and oesophagus, there is evidence of inoculation metastases being placed in the puncture channel via thread pull-through method. To avoid this, a direct puncture procedure can be selected for patients with curative therapy concept.

Hypergranulations Peristomal hypergranulations can be treated with silver nitrate sticks or undergo local treatment with argon plasma coagulation (APC). A balloon system can also be inserted for decompression.

Tube Problems The tube can become occluded in cases of insufficient care (Fig. 7.19) or due to administration of medication. Correct flushing of

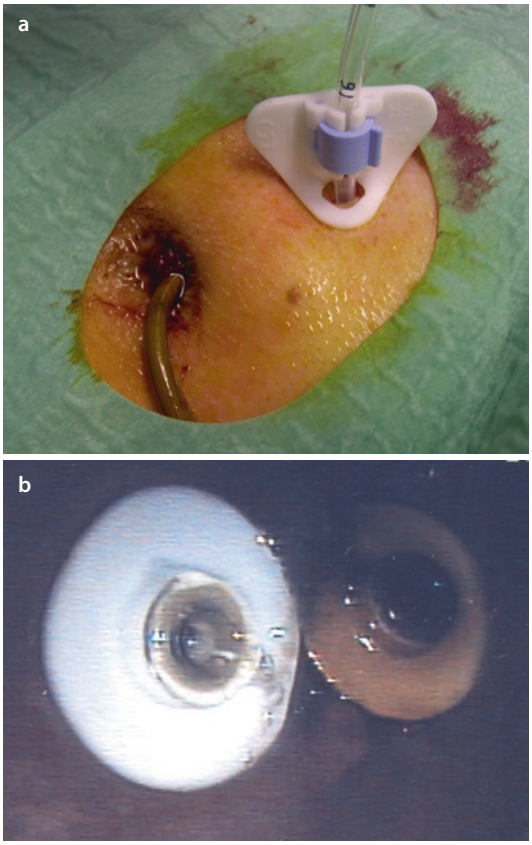

Fig. 7.18 Simultaneous removal and new positioning of an infected PEG: **a** gastric, **b** cutaneous view

the tube is therefore imperative to avoid this complication. Once the catheter is occluded, it can be attempted to make accessible the tube by administering mineral water, pepsin wine, Multibionta or Coca-Cola under pressure. Over time, changing of the tube is usually the best solution. If the tube is torn (Fig. 7.20) or if there is damage to the gastric part of the catheter, the tube must be removed endoscopically. In cases of proximal damage, the tube can be shortened and mended by a repair set.

Peristomal Leakage or Development of Ascites In these cases, a peristomal secondary fixation to the stomach wall using the gastropexy device is possible, so that the leakage developed due to ascites is neutralized (Fig. 7.21).

Buried Bumper Syndrome (BBS) Growing of the internal fixation plate into the actual stomach wall is a complication that can be avoided. BBS is a complication that can be avoided through adequate care

Fig. 7.19 Tube obstructed through food residues

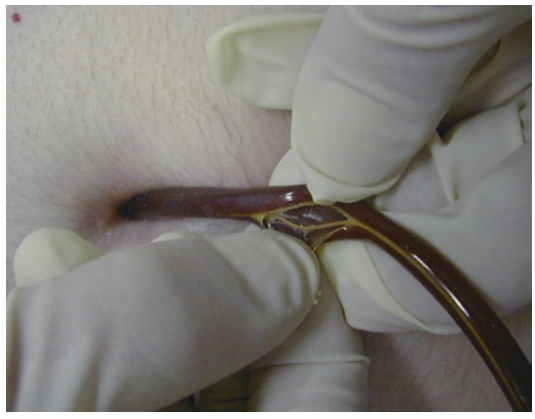

Fig. 7.20 Tear at the tube due to local therapy with PVP ointment

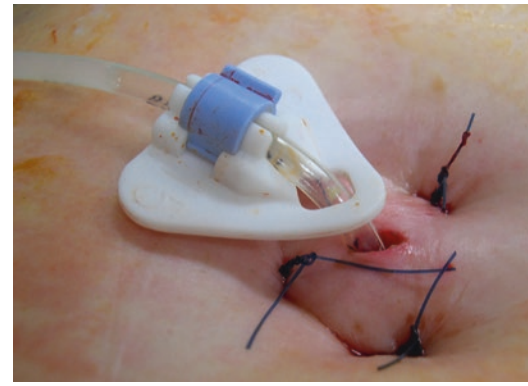

Fig. 7.21 Hybrid PEG through combination of pull-through and direct puncture procedure in case of development of ascites

and management of the PEG. Continuous pulling on the PEG and/or lack of regular mobilization of the plate can lead to the plate being buried by the stomach's mucous membranes, lowering of the plate into the stomach and abdominal wall and local chronic-inflammatory changes, which, in the end, can lead to an occlusion of the feeding tube. This can occur as early as 2–4 weeks after initial insertion of the feeding tube. Various therapeutic methods are available for treatment: surgical repair through laparotomy, local surgical removal via radial cut along the tube and plate from the outside and removing the plate by pulling from the outside (so-called pull method) or endoscopic removal of the plate from the inside. In recent years, a new endoscopic procedure (push method) has been established to expose the ingrown plate (Müller-Gerbes et al. 2009): Under endoscopic control, the ingrown plate is freed via papillotomy via the inserted PEG (Fig. 7.22a–d). Then, the patients receive a gastrotube (high-volume-low-pressure concept) via the already existing stoma or get a new PEG, and the stoma can heal.

Aftercare Following Tube Insertion

The dressing is changed after 24–48 h, under sterile conditions, while mobilizing and turning the tube, which is then fixed again while slightly pulling. A standardized procedure is required. During the first week, after insertion of the tube, the dressing should be changed daily and, after that, 2–3 times per week. Sometimes, a dressing is not necessary. If the wound is free of infection

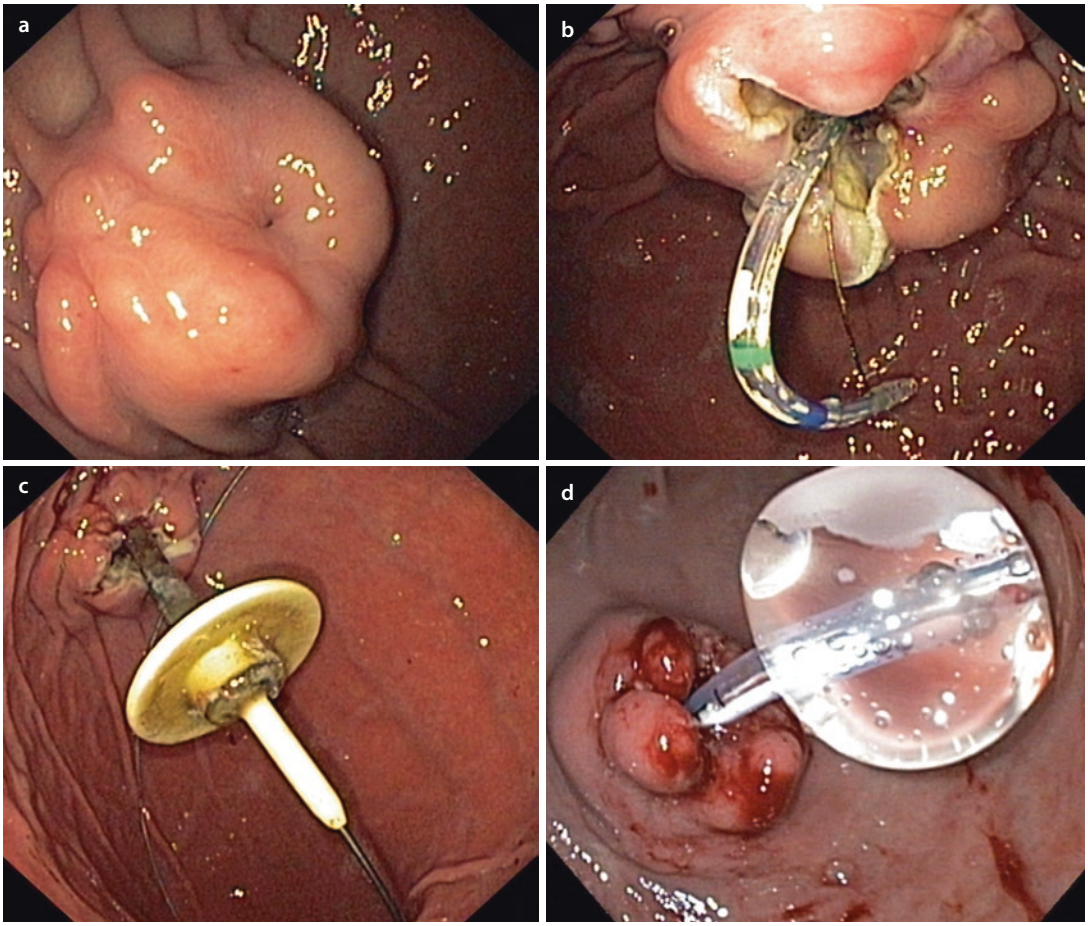

Fig. 7.22 Performing push method for the management of BBS: **a** BBS, **b** cut with papillotomy in four segments, **c** dilation via bougie and freeing of the internal fixation plate (push method), **d** gastrotube in situ (high-volume-low-pressure concept)

and inflammation, normal body hygiene is not limited. Bathing and showering is usually possible 1 week after insertion of the tube. After the application of food and before and after administration of medication and at least once a day if no feeding has taken place, the tube needs to be flushed with at least 20 ml of water. In addition, the adapters should be cleaned daily using clear water.

Beginning Feeding via Tube Tea or suitable enteral nutrition can be administered via tube, 4–6 h after insertion of the tube. Increase of food intake should primarily take place via pump with low drip rate.

Changing the Tube A particularity of the direct puncture PEG is that the holding suture must be removed after 10 days and that the primary balloon system should be changed into a secondary system after 30 days (▶ Sect. 5).

The pull-through tube is only exchanged when needed, e.g. in case of mechanical damage or dysfunction (▶ Sect. 4).

7.4 Jejunal Percutaneous Tubes (PEG with Jejunal Port/PEJ)

Indications/Contraindications

Additional endoscopic procedures to the jejunal transcutaneous tube insertion include the percutaneous endoscopic jejunal tube (PEG with jejunal port: lengthening of the PEG via jejunal catheter) (Fig. 7.1) and the percutaneous endoscopic jejunostomy (PEJ: insertion of a PEG tube into the jejunum). With the excep-

Table 7.2 Indications for percutaneous jejunal tube insertion

PEG with jejunal port or PEJ	PEJ	PEG with jejunal port
Recurring vomiting Aspiration Reflux Gastroparesis Retroperistalsis Pylorus stenosis	(Partial) stomach removal PEG not possible	Gastric deviation *and* jejunal feeding required

tion of patients with a removed stomach, the indication for a jejunal tube is usually determined using the clinical development and usually in the case of problems associated with an inserted PEG (e.g. reflux, aspiration, pylorus stenosis, motility disorders, etc.) (Table 7.2). Currently, there are no clear guidelines for the primary placement of a PEJ. The indication in case of recurring aspirations due to reflux is not proven. Nowadays, the procedure used more often is the PEG with jejunal port. The contraindications correspond to those of a PEG insertion (▶ Sect. 7.3) (Fig. 7.23).

Preparation and Prophylaxis of Complications

The same conditions apply as for the pull-through PEG. To reduce a local infection, antibiotic prophylaxis is required in the PEJ, and it corresponds to that used during PEG insertion.

Preparation of the Patient

→ Corresponds to that of inserting the PEG

Personnel-Related Requirements

→ Corresponds to that of inserting the PEG

Instrument-Related Requirements

As is the case in every interventional endoscopy, continuous measuring of O2 saturation (pulse oximetry), taking of the blood pressure with documentation and, in patients starting at ASA III, an EKG deviation are required (Figs. 7.24, 7.25, 7.26, 7.27 and 7.28).

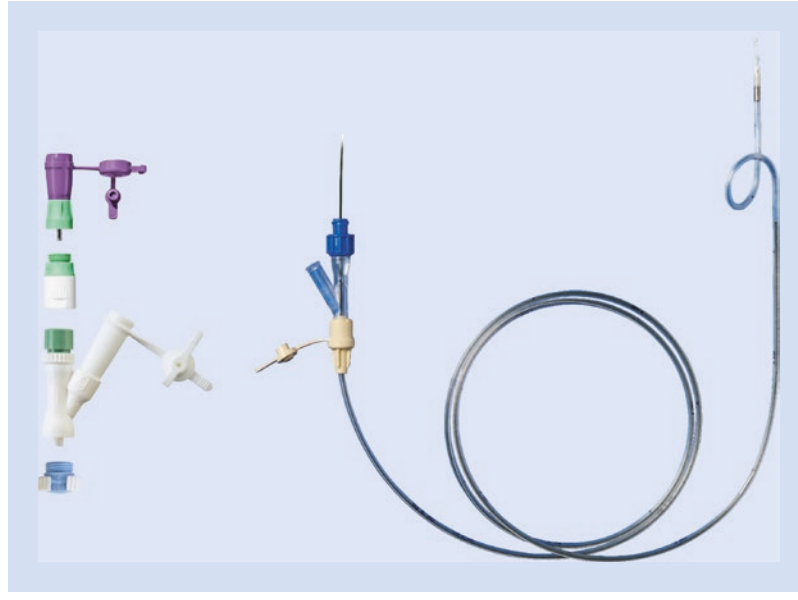

Fig. 7.23 Jejunal port Feka 9CH (Courtesy of company Fresenius)

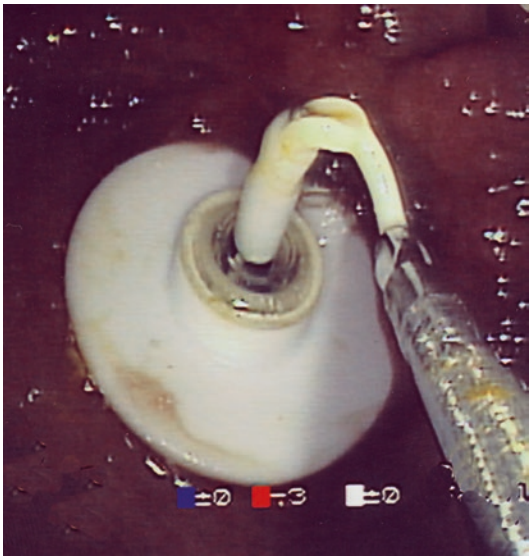

Fig. 7.24 Grabbed distal end of the PEG

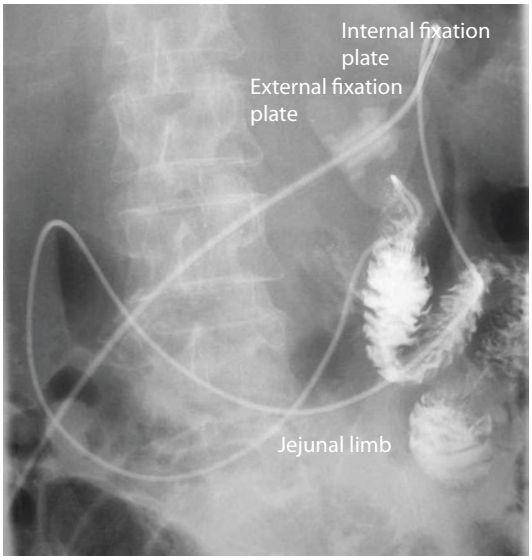

Fig. 7.26 PEG with jejunal port in situ

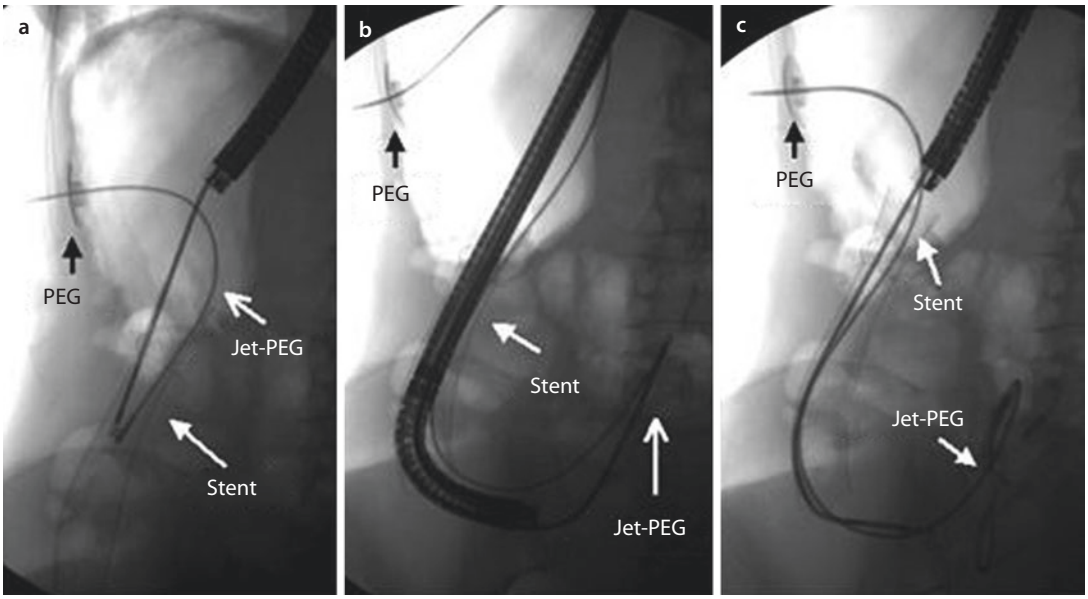

Fig. 7.25 Insertion of a PEG with jejunal port (Jet-PEG): **a** grabbing of the tube and beginning of advancing, **b** passage through the stent and further advancing, **c** retreating of the gastroscope and freeing of the tube

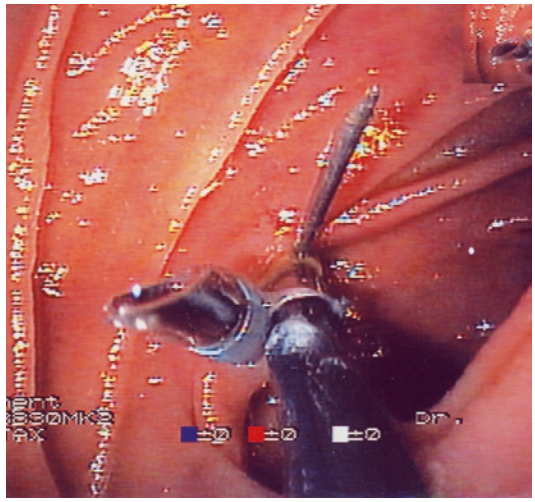

Fig. 7.27 Affixed anaesthesia needle during puncture of the small intestine

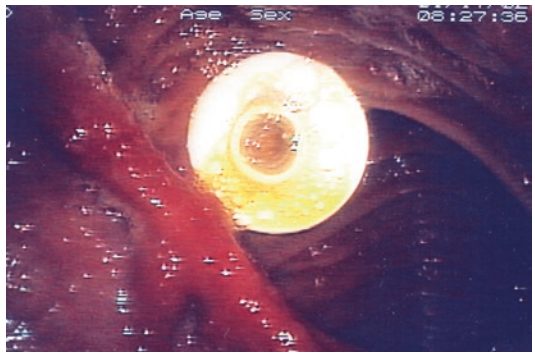

Fig. 7.28 PEJ tube in Billroth II surgery in situ

Particularities of PEJ insertion:

- Spasmolysis: immediately prior to puncture, administration of N-butylscopolamine to suspend the vivid peristaltic of the small intestine.
- Endoscopy may not be performed if there is no diaphanoscopy.
- The local anaesthesia needle and later on the trocar needle are affixed in the small intestine using the forceps (Fig. 7.27).
- The position should be checked endoscopically or radiologically after having pulled through.

PEG with Jejunal Port

If a PEG CH 15 is inserted, it should be exchanged for a PEG set 20 CH. This procedure requires a standard set PEG CH 20 as well as the jejunal port with 9 CH (Fig. 7.23), which is particularly recommended when a gastric deviation is required in addition to the jejunal feeding. If it involves feeding only, a CH 12 insertion tube can be inserted into the CH 20 PEG, the position of which is more stable and does not clog up as often.

In addition, the following are required:

- Long endoscope (prepare paediatric colonoscope or colonoscope)
- Strong grasping forceps for the jejunal port
- Sling for removing the PEG (with a diameter of about 3 cm)
- Fluoroscopy option, e.g. C-arch

PEJ

The preparations for a PEJ correspond to that of a PEG (▶ Sect. 3). The following are required:

- N-Butylscopolamine 10–20 mg
- Long endoscope (prepare paediatric colonoscope or colonoscope)
- Surgical standard for application with sterile gloves
- Fluoroscopy option, e.g. C-arch

Practical Development: PEG with Jejunal Port

Initially, the inserted PEG (usually CH 15) is exchanged for a bigger one (usually CH 20). That makes sense, since less problems develop over the course of time (occlusion) caused by the internal catheter to be then placed. Technically, insertion of a 9 CH insertion tube into a 15 CH PEG is also possible.

To change the PEG, grab it with a sling from gastric direction and shorten it to about 3 cm above the abdominal wall. Prior to that, attach the pull-through thread to the PEG tube on the outside and then place the new PEG corresponding to that of the pull-through method. Finally, a jejunal catheter (usually CH 9) can be inserted through this PEG, in gastric direction.

Usually, the insertion technique «beneath the scope» (BTS) is used here. This procedure includes endoscopic gastric grasping of the distal end of the inserted tube using strong and long

forceps (Fig. 7.24), and then using the device, it is guided towards intestinal direction. If further endoscopy is not possible, maximum advancing of the forceps along with the affixed tube, which then remains in situ, is done, and at the same time, the device is pulled back. Once the endoscope is in the stomach, the forceps are loosened and slowly reintroduced into the device. This technique is particularly helpful when inserting intestinal tubes, e.g. a jejunal tube (▶ Sect. 4) (Fig. 7.25), which is the reason why these tubes are inserted under radiological control. A successful outcome is dependent on a secure jejunal placement as well as on avoiding the intragastrical formation of loops (Fig. 7.26). If the jejunal port of the tube is positioned in the area of the proximal duodenum, the tube might return, which, in the worst-case scenario, causes an aspiration.

Practical Development: PEJ

As opposed to that procedure, the preparation and insertion of a PEJ using the pull-through method by and large corresponds to that of a PEG being placed in the jejunum. That is a significant advantage compared to the PEG with jejunal port, since a secure placement of the tube in the jejunum is achieved.

During the initial insertion, the diaphanoscopy in the area of the duodenojejunal flexure or in aboral direction of the same is determined using a long endoscope (paediatric colonoscope, colonoscope, enteroscope). In rare case, depiction of the diaphanoscopy is very difficult and is often only possible in very dark rooms. Afterwards, the intestinal peristaltic is decreased using Buscopan, and trial puncture is performed using a thin cannula. If the cannula is securely positioned intraluminally, it is grabbed with the grasping forceps, thus ensuring that the intestine is securely affixed to the abdominal wall. Now, puncture the intestine positioned next to the cannula using the puncture cannula from the standard PEG set. If the cannula appears intraluminally, the introduction aid is advanced, the grasping forceps are removed from the cannula, and the thread positioned in the introduction guide is grabbed. This thread is then moved in oral direction, and the tube is affixed to the same and moved into the final position via pull-through technique as is done when inserting a PEG. Compared to the PEG with jejunal port, the significant benefit of this procedure is being able to achieve a secure placement of the tube in the jejunum (Figs. 7.28 and 7.29).

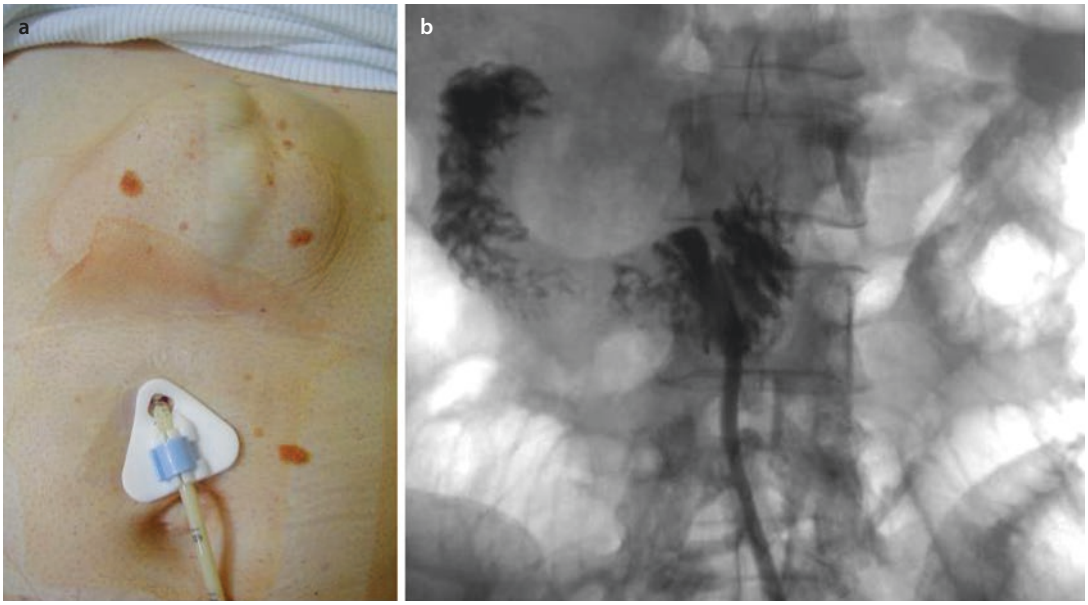

Fig. 7.29 PEJ insertion at large gastric hernia: **a** view from outside, **b** radiological control of the position

Complications and Management of the Same

Complications of inserting a PEG with jejunal port are due to the endoscopy being performed while the patient is lying on his back and, in the case of longer-lasting interventions, the danger of aspiration.

Complications occurring after surgery are comparable to those after the insertion of a pull-through PEG, whereas intestinal injuries do occur more often.

Standardized Aftercare After Insertion of Tube

Wound care and aftercare are identical with that of the PEG. Initiation and increase of food intake can also be started after 4–6 h, whereby the maximum rate of the enteral nutrition that must always be administered via pump may not exceed 150 ml/h; otherwise, the patient can develop diarrhoea.

The tube must be well cared for, which is a requirement for successful use. Dislocation of the jejunal port is the first sign of incorrect care. For example, if the tube is turned, it may end up with knots in the jejunal port (Fig. 7.30).

Application of medication should be avoided. The deciding advantage of this procedure is the possibility of a gastric decompression at parallel jejunal feeding. This way, enteral feeding also becomes possible for problematic patients (especially neurosurgical patients with extensive retroperistalsis).

All other procedures of the sonographically or radiologically controlled tube insertion are only indicated in patients where insertion of a PEG is impossible.

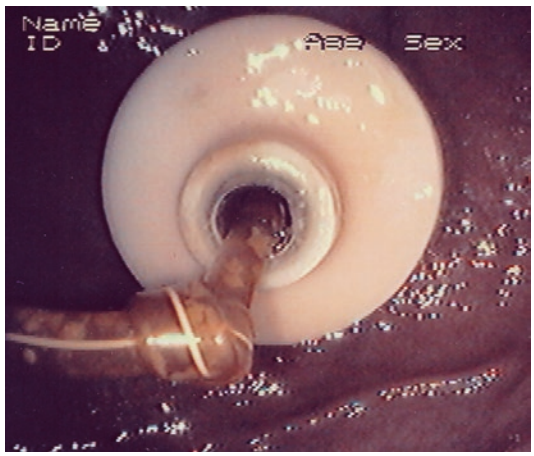

Fig. 7.30 Knot at the internal fixation plate when attempting to pull back

Surgical procedures should only be used in cases where no tubes can be placed using endoscopic or alternative procedures. When effectively using the available techniques, that would amount to less than 1% of the cases.

The **fine-needle catheter jejunostomy** (FNJ, lap-FNJ = direct surgical insertion of a jejunal tube) is an exception. If the patient is undergoing a laparotomy, this tube procedure should be used so as to avoid a second intervention. Emergency patients with abdominal trauma or elective patients with visceral surgical interventions (removal of the oesophagus or stomach) would be predestined for this. These tubes can then also be used for temporary postoperative feeding as is the case with other jejunal tubes. They cannot, however, be exchanged. If endoscopic procedures are not possible and long-term tube feeding is planned, the classic procedures according to Witzel and Kader that can, of course, also be performed laparoscopically can be used.

7.5 Secondary Techniques (Button, Gastrotube)

Gastrostomies are used for long-term feeding of patients suffering from various underlying illnesses. In these cases, the catheter varying in size penetrating the abdominal wall due to constant swivelling and shear movements can lead to local problems such as leaking, infections or granulations. If the application of a dressing becomes necessary in these situations, it reduces the patient's comfort, but on the other side, it can also result in complications such as irritation of the skin, allergies or macerations. A reflux from the gastrostomy canal or the catheter can also have the disadvantage of being an odour nuisance or causing skin irritations. In some patients, these problems lead to a generally critical opinion regarding long-term enteral feeding. In addition, many patients are significantly limited and stigmatized in their general state of health and their social integration. This applies to children and people being actively integrated into social life, in particular.

The so-called valve button or button systems (synonyms: button gastrostomy, «skin-level gastrostomy/device,» «gastrostomy replacement button») are improvements compared to permanently inserted stomach catheters, which have been used as secondary systems after initial PEG insertion

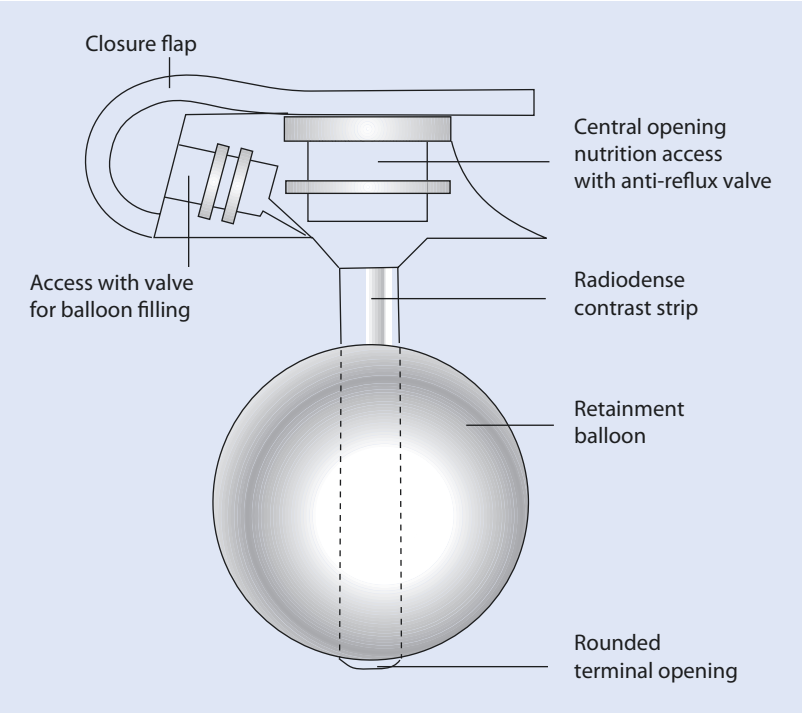

Fig. 7.31 Setup of button

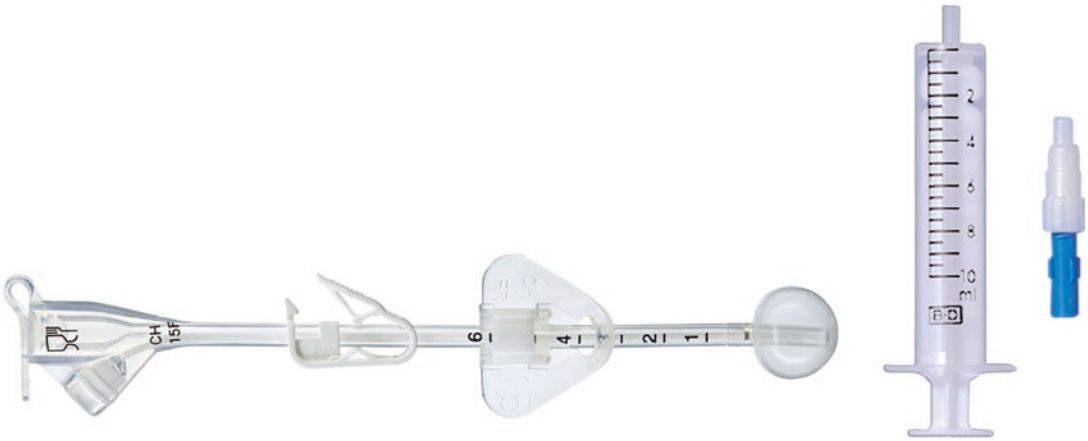

Fig. 7.32 Fresenius gastrotube (Courtesy of company Fresenius)

since 1984 (Gauderer et al. 1984). These systems are significantly smaller than PEG systems, are less obvious and therefore provide the patient with the possibility of an improved cosmetic result while at the same time increasing mobility.

Button and gastrotube systems are replacement and secondary systems that can be changed 4 weeks after insertion of a gastric PEG, if the stoma canal is free of infection and inflammation. The typical button is made of latex-free silicone rubber, and a balloon serves as a retention mechanism (Fig. 7.31), which is filled with isotonic saline solution administered through a lateral valve. Other systems are not established in Germany and are therefore not depicted.

The gastrotube is a balloon catheter that can be placed as a secondary system or that can be placed in the stoma replacing defective tubes (Fig. 7.32).

Use and indication correspond to that of a button; the longer tube is beneficial for many patients, facilitating the attaching of enteral nutrition.

Indications

Indications for insertion of a button:
Local problems:
- (Pressure) ulcer
- Eczema
- Allergies (e.g. bandages)
- Peristomal granulations
- Leaks

Other reasons:
- Cosmetic reasons
- Social stigmatization in children and adolescents
- Protect from injuries (children and geriatric patients)
- Desire for more mobility

A clear indication is a requirement when using secondary systems, as is the case when inserting a PEG. Some patient groups are predestined for the insertion of a button due to their underlying illness and mobility (Dormann et al. 1998).

As per our experience, button stomas are indicated in the case of local stoma problems, which affect about 10% of the patients. The problems usually consist of care-related problems, caused by allergies to bandages and/or care products that partly also lead to chronic eczemas. Sporadically, we also saw pressure-related granulations that healed after the implantation of a button system. In cases of leaking and peristomal leaking, insertion of a button can directly lead to the arrest of secretions leaking and thus proves to be a clear indication. Usually, however, the button systems are used for cosmetic reasons or due to the patient's desire for more mobility.

Primary patient groups receiving a button system include patients exhibiting a sufficient compliance and who benefit from the system. That includes paediatric patients and adolescents, in particular, who benefit from cosmetic advantages. But risk patients, e.g. children under haemo- or peritoneal dialysis, can also receive a button system. It must be noted, however, that the button can become dislodged in toddlers while crawling. Neurological patients, especially patients with isolated swallowing disorders, e.g. at amyotrophic lateral sclerosis, are also suited for the insertion of a button. The same applies to patients suffering from tumours of the hypo- and oropharynx and of the oesophagus. Nowadays, it is usually a standard procedure for these patients to receive a PEG prior to initiation of a chemo- or radiotherapy. During the therapy breaks, a button system can be inserted. In patients that can eat again during the remission of a primarily non-curable carcinoma, the button serves as a placeholder and can be used again for enteral feeding therapy when there is another progression.

Using a button system in geriatric and psychiatric patients who may accidently dislodge a PEG system protects the patient from experiencing stoma injuries. In this case, the use of a button can also make sense.

Contraindications

An active stoma infection is a contraindication for the elective insertion of a button when pathogens can enter the fistula and cause an exacerbation of the infection. In these cases, it is better to eradicate the local infection through intense, locally disinfecting or possibly also systemic antibiotics and to then implant the button. A PEG that is no older than 2–4 weeks should not receive a button primarily, since a good formation of the stoma canal is a prerequisite. Inserting a button sooner is not recommended, since malpositionings are possible. A long (>4.5 cm) or very curvy fistula canal can also lead to significant problems incl. perforations of the stoma canal and extragastric placement of the button. Should placement of a button not be possible, another placement of a PEG would be indicated.

Based on own experiences, patients, whose insertion of a PEG was primarily very difficult or endoscopically impossible, should not receive a button system. Due to defective material but also due to accidental dislocations, the patients can experience occlusions of the stoma within a short period of time, so that another insertion cannot take place. In this case, another PEG must be placed, which has significant negative consequences in some cases, such as another surgery.

If a PEG system must be replaced, a gastrotube can be used instead of a button, especially in the case of local infections.

Preparing the Patient

Only very sensitive patients require sedation.

Personnel Requirements

During an endoscopy, at least one endoscopy nurse or experienced staff and one physician must be present. The physicians must be experienced in endoscopy and in the use of the application technique required, since, depending on the site, a modification might be necessary. If the patient still has a pull-through PEG, an endoscope must always be used to remove the fixation plate, which requires analgosedation of the patient. This must be discussed during the planning phase.

Instrument-Related Requirements

- A sterile table must be prepared especially for this examination, containing the following:
  - Button/gastrotube set (Figs. 7.23 and 7.33c)
  - Seldinger wire set
  - Incise drape
  - Gauze pads
  - Dressing set with y-gauze pad
  - Syringe 10 ml with NaCl 0.9%, for blocking
- Endoscope, standard.
- Sling for removing the PEG.
- Bougie for increasing to 15 CH, if the stoma is too narrow.
- Scissors.

The intervention can be performed with a fluoroscopy option to check on the position; otherwise, x-rays must be performed afterwards.

In most cases, the insertion can be performed on an outpatient basis. As opposed to the primary implantation of a PEG and other interventions at the gastrointestinal tract, a periinterventional antibiotic prophylaxis is not required, since the already-present stoma canal can be used (Dormann et al. 1999).

Practical Course: Button (Modified Seldinger Technique)

The initial application of the buttons as secondary system after placement of a PEG usually takes place under endoscopic control and is similar in all button systems.

Later, a possibly necessary changing of the button can, if the respective experience is present and if the stoma is in a good condition, also take place without endoscopy. The secure gastric placement must then, however, be clinically proven through sure aspiration of gastric content and if there are any doubts radiologically.

The endoscopic procedure provides the possibility of safely removing the internal fixation plate, and on the other side, the internal stoma can be inspected, so as to rule out pathological changes, such as an ingrown fixation plate. The passage of the button in gastric direction can be controlled endoscopically, and malpositioning can thus be avoided. Initially, the Seldinger wire is inserted through the inserted tube, so that a safe passage can be ensured. The PEG is then endoscopically removed, by grabbing the sling and cutting it above the abdominal wall back to about 4 cm. After that, it is being pulled back into the stomach using the gastroscope.

At the same time, the length-measuring device is inserted into the stomach, through the stoma, via the inserted wire, to determine the required shaft length of the button. The length is determined while the patient is lying down and also while sitting. A button shaft length of 10–15 mm longer than the measured stoma length is ideal. The length-measuring device remains in the stoma as a placeholder, while the button to be inserted is checked (Fig. 7.33). The function of the balloon is checked with a Luer syringe containing 6.0 ml of 0.9% NaCl. If it functions, the balloon's complete contents must be sucked out of the balloon so as to allow a good passage of the stoma. If a guidewire is present, which can be helpful in the case of a narrow stoma, it must be advanced through the button, for easier placement into the stoma. Measuring the length of the device and advancing of the button covered in lubricant into the stomach follow immediately thereafter. If the button becomes endoscopically visible in the stomach, the balloon can be filled with 5–7.5 ml of NaCl 0.9% through the lateral valve. The guidewire and the wire are then removed from the button. When pulling out the gastroscope, the physician also removes the cut PEG.

In rare cases, when the passage of the button through the stoma is more difficult, a guidewire (e.g. 0.035″) can be used as a splint. If the stoma is too small, a guidewire might have to be used for dilating the stoma canal. This procedure requires some experience in the use of button systems and should only be used in rare cases.

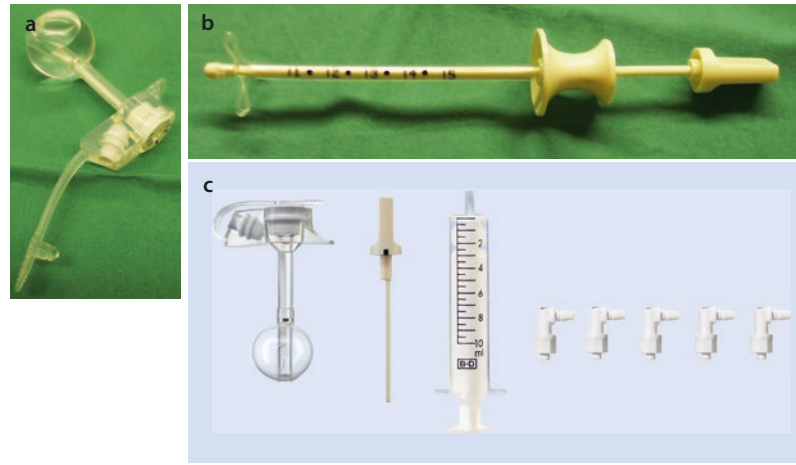

Fig. 7.33 **a** Blocked button, **b** measuring device to determine the length of the stoma, **c** button set with mandrin and adapter (**c** Courtesy of company Fresenius)

The length of the button and the filling volume must be documented in the patient pass, which must be handed to the patient after the intervention.

Changing of the Button If a defective button is to be exchanged under good local conditions, trained personnel can perform the same via Seldinger technique, without another gastroscopic control. Hereby, however, the danger of the button not being positioned intragastrically does exist and might lead to the administration of enteral nutrition into the free abdominal cavity. The longer the already-present stoma canal, the greater the danger of malpositioning. In cases of longer button systems (>3.0 cm), dislocations in the stoma canal might occur (Romero et al. 1996). With an obligatory clinical, endoscopic or radiological control of the position, this complication can be avoided for sure.

■ Practical Course: Gastrotube

The gastrotube is a balloon tube for percutaneous gastrostomy. Insertion of the gastrotube corresponds to that of the button insertion, also using the Seldinger technique. The only difference is that determination of the length is not required.

■ Complications and Management of the Same

Complications are rare and must be controlled. Complications of insertion occasionally include a stoma being too small, which can be dilated via inserted Seldinger wire using a bougie. In cases of bleeding, local haemostasis is usually sufficient.

When the patient experiences lasting pain, the correct position and length of the button should be checked again; if the button is too small, a pressure ulcer can develop within 1–2 days.

■ Standardized Aftercare After Insertion of the Tube

After initial insertion, the blocking of the balloon must be controlled once more before the patient is discharged, so as to rule out a defective balloon. If the wounds are free of infection and inflammation, bathing, showering and doing sports are possible without limitations starting on the day of insertion.

Avoiding food or increasing food intake after insertion of a button is not necessary.

Application of nutrition and fluid is done through a regular application system. Systems that are connected to a screw connection with a special angular adapter and that are placed into the button (e.g. Freka button) are beneficial. For this, the lid of the button must be opened, and the angled adapter must be put into the central valve in such a way as to ensure that the black marks at the adapter and at the opening of the button are aligned with each other. Afterwards, the angled adapter is turned 90 degrees clockwise for fixation purposes, and the application of food or fluids can begin.

The angled adapter should be changed every 3 days and the tubular system, however, after 24 h. The angled adapter must be rinsed after every use or cleaned with a small brush, if needed.

Every commercially available enteral nutrition is suited for the application. Bolus as well as gravity or pump application can be used in the button. Bolus application is preferred especially by young, active patients. The pump application allows for a

very exact and secure dosing, also in the case of mobile patients. Due to the wide array of mobile systems available for enteral nutrition, the patient is free during pump application and can move around freely.

Flushing the button daily using a Luer syringe (20 ml of fluid, e.g. boiled or distilled water) is urgently required so as to avoid occlusion. The syringe filled with the rinsing fluid can be placed onto the central valve directly after opening of the closure, and the button can be flushed. The flushing fluid can also be administered through the extension tube for nutritional tubes or tubing systems. With the assistance of good training measures, changing of the button due to occlusion can be avoided in the long run. Medication is also administered through a Luer syringe that is inserted into the central opening of the button. Viscous fluids and strongly concentrated alcohol-based solutions must be diluted prior to application. Solid medication must be pulverized and completely dissolved in 10–20 ml of water. Before, in between and after administration of the various individual medications and flushing the button are of particular importance. If the wound is free of infection and inflammation, application of a dressing is not necessary.

Daily cleaning of the covered surface and of the puncture site, using mild soap and warm water, is advised, which must be followed by disinfection of the skin. The button should be turned and moved once a day so as to avoid pressure ulcers.

Every 4 weeks, the filling of the button balloon should be checked by a trained person. The filling amount must always be documented. If the initial amount is not present anymore, the valve must be checked for leaking. If further volume is lost within 24 h, the button must be exchanged. In cases of a spontaneous rupture of the balloon or if the button falls out, it should be retained in the stoma using dressing (if possible). Another insertion of the button after a short period of time is extremely important, since the stoma would otherwise close up within few hours. In some cases, e.g. while on vacation, it would be beneficial if the patient had an available replacement button, so that a fitting button would be available and could be replaced quickly in case of a defect.

If patients gain weight under administration of enteral nutrition, the button must be exchanged for a button with a longer shaft in a timely manner, so as to avoid pressure ulcers or infection of the stoma.

In addition to a good patient selection, precise training is a deciding factor for the long-term success. This should take place at the hospital, and the patient and people from this environment should be made familiar with the particularities of a button. A pass, information material and care standards provided by the manufacturers support these training measures.

7.6 Percutaneous Endoscopic Colostomy or Caecostomy

Indications and Contraindications

The percutaneous endoscopic colostomy/caecostomy (PEC) serves the purpose of decompression in the case of acute or recurring obstructions of the colon (e.g. Ogilvie syndrome) and other forms of intestinal pseudo-obstructions. This procedure can also be used in acute, therapy-resistant infections, e.g. for local therapy in case of *Clostridium difficile* (pseudomembranous colitis). The PEC can also serve as irrigation access in case of chronic constipation.

Intestinal necrosis/ischaemias and (suspected) intestinal perforation are absolute contraindications. The same applies to ascites and coagulation disorders.

Preparation and Prophylaxis of Complications

→ Corresponding to PEG, possibly primary use of PEG CH 20:

→ Have available colonoscope

→ Have available pull-through PEG tube and direct puncture set

Personnel and Instrument-Related Requirements

→ The same as PEG

Practical Course

Initially, endoscopy up to the coecal pole, if possible, insufflation of CO2. After depiction of the diaphanoscopy and local anaesthesia of the abdominal wall, the intestinal lumen is punctured. If the caecum position is identified without a doubt under the abdominal wall using diaphanoscopy and fingertip attempt, a cannula is usually used to puncture.

A modified measure includes a combination between pull-through technique and gastropexy-secured direct puncture procedure. For this, 2–3 security stitches are inserted prior to insertion of the puncture cannula, so as to securely fixate the intestine. Afterwards, deep punch incision about 1 cm in width and introduction of the puncture cannula from a regular set are done. After having retracted the puncture needle, the introduction sheath remains in the caecum. A pulling thread is introduced through the same, grabbed with the grasping forceps and then pulled through the instrumentation channel as completely as possible, from the endoscope towards anal direction, and when pulling back, the air is sucked out of the colon. The PEG tube is attached to the end of this thread and then pulled through the intestine. At the end of the procedure, the internal fixation plate must be at the intestinal wall. Finally, the exterior fixation plate and a standardized dressing are applied. The tube must be affixed with slight pressure, so as to ensure adhesion. Further wound care as per PEG care is followed (Dormann and Deppe 2002).

▪ Complications and Management of the Same

The most important complications correspond to those associated with the insertion of a PEG. The tube can be used immediately for deviation and 4–6 h after the insertion for application. Due to the very thin wall of the colon, only slight pressure should be used for the fixation of the exterior fixation plate, so as to avoid ischemia. For these reasons, insertion of a combination procedure is recommended.

7.7 Endoscopic Procedures in Metabolic Illnesses

Besides personal reasons for the reduction of obesity, there are also medical reasons for planning an obesity therapy, which particularly applies to diabetics. This therapy often encompasses a multimodal concept. In addition to a nutritional and movement therapy as well as medicamentous therapy, surgical procedures offer the best success rates nowadays. In recent years, endoscopic therapy of obesity has become part of the therapeutic concepts of weight reduction. Reducing weight can help overweight patients prevent or delay the onset of type II diabetes mellitus. The weight reduction leads to an improved metabolic condition, which is often reflected in the decreased need for medication, to include insulin. Consequently, reducing excessive weight can even lead to insulin-dependent type II diabetes patients not needing insulin anymore. The following should therefore depict the possibilities of endoscopic therapy in the case of obesity.

7.7.1 Gastric Balloon

The oldest and best-known endoscopic intervention for treating obesity includes the insertion of a gastric balloon. In 1982, this intervention was performed for the first time. Since then, the technique has evolved and has spread to obesity centres. The gastric balloon is made of a soft and expandable material. Prior to insertion, it is very small, so that it can be inserted through the mouth without any problems. The main indications for a gastric balloon are patients who cannot be subjected to a planned surgery due to their extreme obesity, since they would otherwise be exposed to unjustifiable surgery risks. A gastric balloon can therefore be inserted prior to a planned surgery. After this intervention, it is usually easier for the patient to lose the required weight. Usually, the gastric balloon remains in place for 6 months. Manufacturers recommend the gastric balloon not to remain in place for more than 6 months. Over time, the acid-containing gastric content weakens the balloon material and leads to a deflation of the balloon. Should longer treatment be required in special cases, the gastric balloon has to be exchanged every 6 months.

▪ Insertion of a Gastric Balloon

A gastric balloon is inserted during a gastroscopy, under analgosedation. It is important that the periinterventional risk of sedation is assessed prior to the intervention and that an anaesthesiologist is present, if needed. The gastric balloon is placed into the stomach during the endoscopy and under view is filled with fluid. By filling the balloon, it expands to its final size (◘ Fig. 7.34a–c). Depending on the desired degree of expansion, the balloon is filled with 400 to 700 ml of fluid. Newer balloons can also be filled afterwards, thus increasing the volume gradually. The fluid can be stained to take on a blue colour, so that a possible defect of the balloon can be detected. Should the balloon lose fluid due to some type of damage, the coloured fluid is absorbed through the intestines

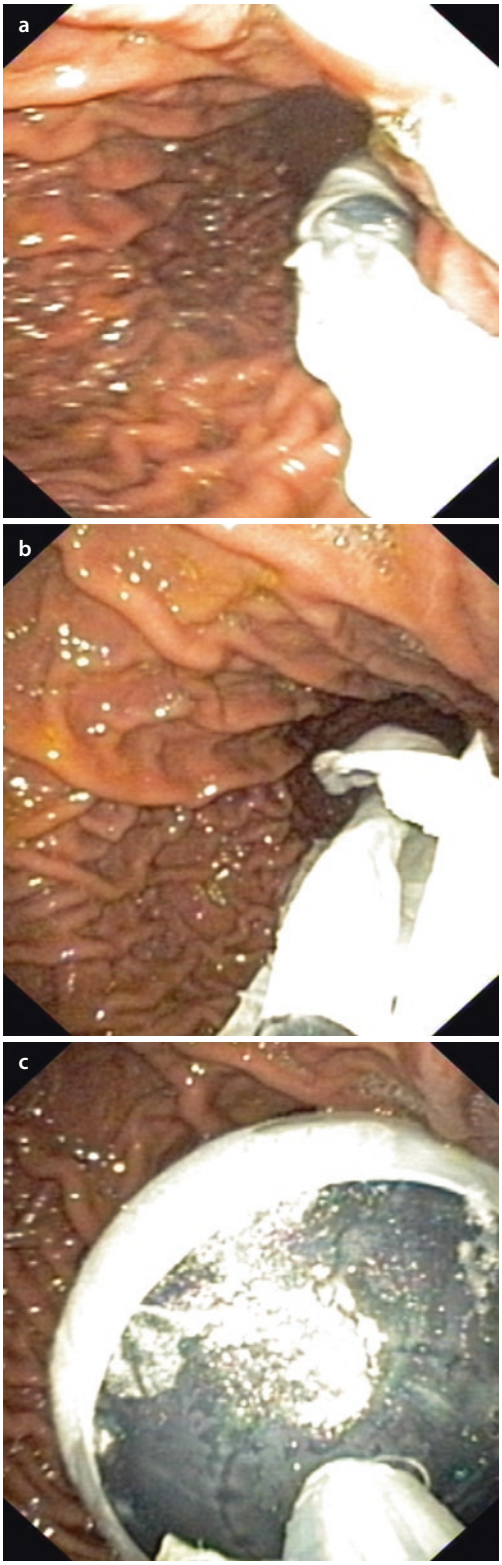

Fig. 7.34 Insertion of the gastric balloon: **a** gastric balloon prior to unfolding in the stomach, **b** beginning of filling, **c** final state of balloon in situ

into the blood and then excreted via the kidneys. The discoloured urine reveals the defect of the gastric balloon. A defective balloon must be removed.

Risks

During the passage, the oesophagus and stomach can be injured, either through direct contact with the instruments being used for inserting the balloon or through the gastric balloon itself. Due to the increased production of acid in the stomach, the patient can also experience reflux or develop ulcers. Further problems can include severe pain; bleeding and perforation of the gastric balloon are very rare. A bacterial contamination of the balloon fluid can lead to infections, fever, cramps and diarrhoea, if the contaminated fluid reaches the intestine after a rupture of the balloon or when removing the same. Developing an ileus poses another risk, when the spontaneously moving balloon obstructs the intestines.

Aftercare

The patient can experience some problems during the first few days, since the stomach has to get used to the balloon, e.g. nausea, vomiting or diarrhoea and feeling of fullness. In rare cases, the ailments may lead to exsiccosis or electrolyte imbalances requiring therapy. It can take up to 2 weeks until the ailments subside. During this time, the patient often voices the request of having the balloon removed.

Subsequently, in the majority of cases, the insertion of a gastric balloon often leads to a significant reduction in weight.

Removing the Gastric Balloon

If there are no complications, the gastric balloon is usually removed after 6 months. Removing as well as inserting a gastric balloon is an endoscopic intervention with little risks involved. It does, however, require a special kit, with which the balloon is completely emptied via puncture and then extracted with a special grasping instrument.

7.7.2 EndoBarrier

The EndoBarrier method is an endoscopic procedure for treating type II diabetes and for losing weight. It imitates the effects of a bypass surgery according to Roux-en-Y and reduces contact between the food and duodenum/proximal jejunum to 60 cm in length (functional temporary

short intestine syndrome). For this, a flexible tube prosthesis is anchored in the duodenal bulb using a metal wreath with barbed hooks, and the duodenum and the upper jejunum are covered with a foil. It is im- and explanted endoscopically and is always part of the nutritional-medical overall concept.

Implantation of the EndoBarrier: Indications

The EndoBarrier therapy is used for the treatment of patients with type II diabetes, whose diabetes is difficult to control and whose BMI exceeds 30. The EndoBarrier method is intended for a maximum implantation duration of 12 months.

Implantation of the EndoBarrier: Contraindications

The EndoBarrier method is contraindicated in the following patients:

- Long-term anticoagulation therapy
- CED
- Pancreatitis
- Active ventricular or duodenal ulceritis
- Severe reflux disease (GERD)
- Current infections
- Symptomatic CHD
- Severe COPD
- Haemorrhagic diathesis or coagulopathy
- Oesophagus or stomach varices
- Congenital or acquired telangiectasia in the gastrointestinal tract
- Earlier gastrointestinal surgeries that could influence the placement or function of the device
- Symptomatic kidney or gallstone issues
- Insufficient compliance
- Planned or possible pregnancy

Implantation of the EndoBarrier: Preparing the Patient

Three days prior to implantation and up to 2 weeks after removing the EndoBarrier, the patient must take a proton pump inhibitor (e.g. 40 mg omeprazole twice a day). No anticoagulants (aspirin, heparin, NSAID, etc.) are to be taken within 10 days prior to the implantation of the EndoBarrier and during the entire treatment duration. To reduce the risk of infection, intravenous administration of a single dose of 1 g of ceftriaxone (or an equivalent dose of another medication) 30–90 min prior to the intervention is recommended. The patient must be fasting. A secure i.v. access must be present. Sedation with midazolam/propofol or intubation anaesthesia must be carried out.

Implantation of the EndoBarrier: Personnel-Related Requirements

The EndoBarrier may only be used by physicians that are experienced in endoscopic procedures and have received practical training especially for the implantation of the EndoBarrier. The procedure should be performed by two people. Anaesthesia should be performed by an anaesthesiologist.

Implantation of the EndoBarrier: Technical Requirements

Possibility for fluoroscopy; fluoroscopy unit; gastroscope with a working canal of 2.8 mm; Gastrografin, Renografin or equivalent water-soluble fluoroscopy contrast agent; 60 ml, 50 ml and 20 ml syringes; 200 ml of sterile saline solution; and 0.035 inch extra-stiff Nitinol guidewire, e.g. Jagwire Boston Scientific.

The EndoBarrier system is shown in Figs. 7.35, 7.36 and 7.37.

Implantation of the EndoBarrier: Practical Course

The gastroscope is introduced into the duodenum while the patient is lying on the left side, and the area is inspected. Then, under fluoroscopy, the guidewire is advanced into the duodenum. While retaining the wire position, the gastroscope is removed over the wire. While retaining the position of the guidewire, the catheter capsule is advanced via the guidewire into the duodenum. If required, the guidewire can be retracted slightly, so as to lift the capsule into the pylorus. The gastroscope can be used when placing in the pylorus. Then, the guidewire is removed (Fig. 7.38).

The internal catheter is then slowly advanced by pushing the button at the handle (Pos. 1) and by slowly pushing forwards the handle piece. Over time, the button is released so as to pull back the handle; this procedure is repeated. The internal catheter is advanced under fluoroscopy control until it is completely extended up to the most outer distal reference marker at the internal shaft (Fig. 7.39). If there is resistance, pressure is applied forwards, and peristaltic movement is waited on to advance the catheter.

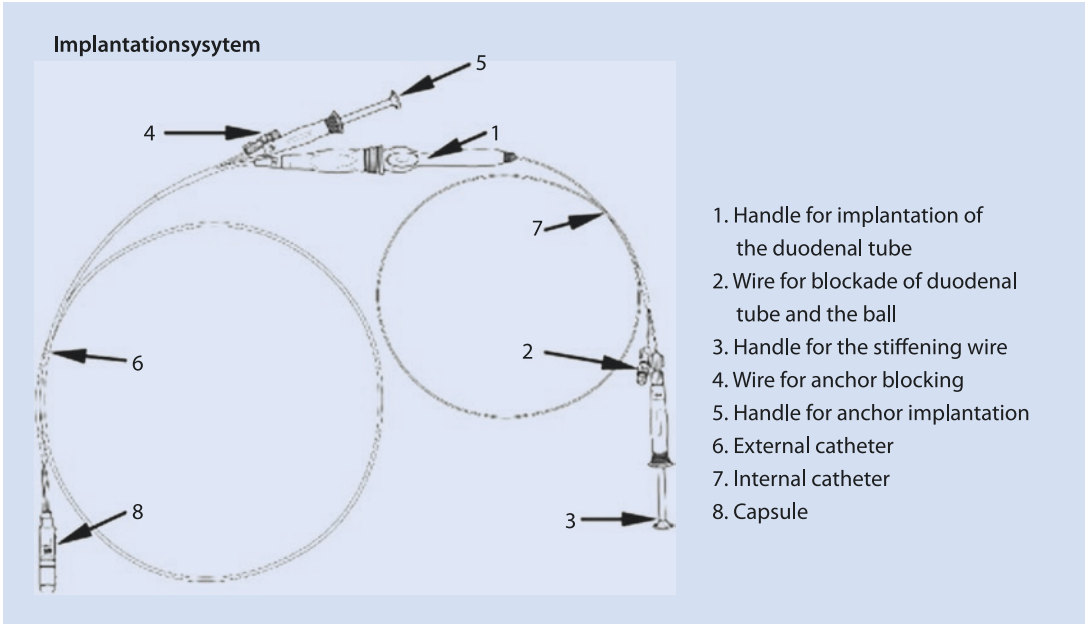

Fig. 7.35 Implantation system EndoBarrier (Courtesy of company GID)

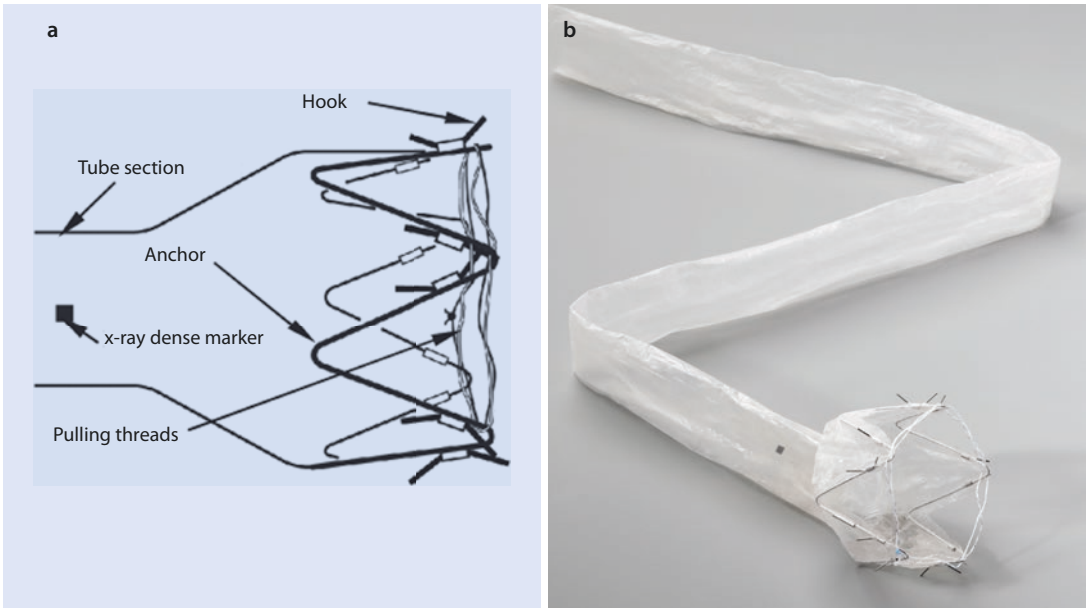

Fig. 7.36 **a**, **b** Fixation tool (Courtesy of company GID)

Then, the blocking wire (pos. 2) at the internal catheter is retracted 10 cm, so as to loosen the distal ball and the tube (Fig. 7.40).

The stiffening wire (pos. 3) is advanced so as to loosen the ball from the distal end of the catheter. It is then checked via fluoroscopy whether the ball is actually removed. If that is the case, the stiffening wire (pos. 3) is retracted back into its stopper position. The gastroscope is then reintroduced into the stomach, and it is assured that the implantation capsule is positioned all the way in the bulb. The blocking wire (pos. 4) of the anchor is then retracted by 10 cm, so as to loosen the anchor. Position the capsule under endoscopic

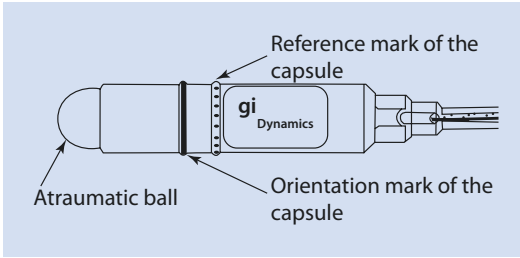

Fig. 7.37 Capsule with system (Courtesy of company GID)

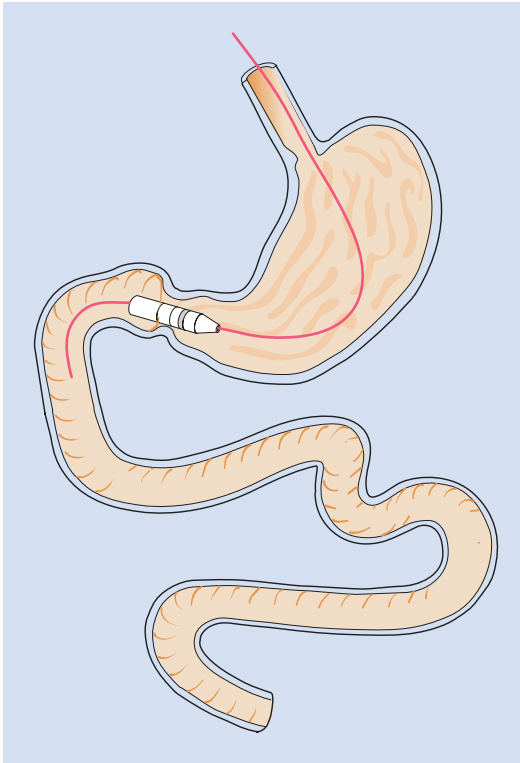

Fig. 7.38 Capsule in situ

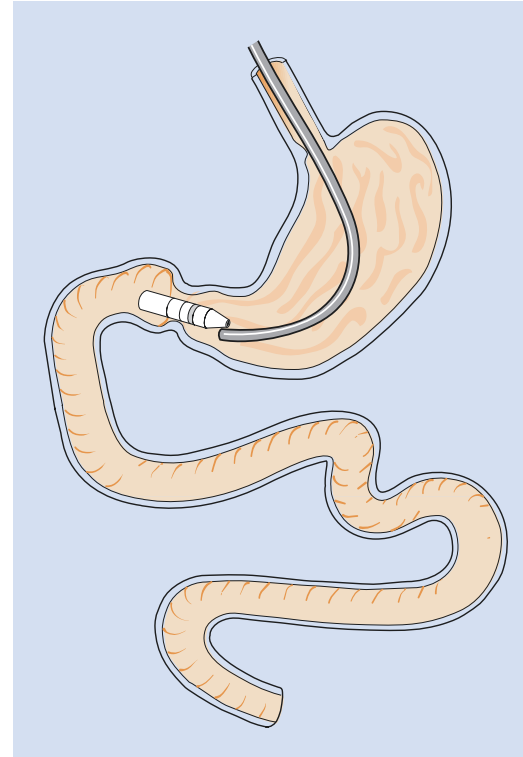

Fig. 7.39 Positioning of the capsule

view, so that the predetermined black capsule marker corresponds to the proximal side of the pylorus. The anchor piston (pos. 5) is advanced to partly push the anchor out of the capsule. The position of the capsule is checked, and the anchor implantation handle (pos. 5) is then implanted by advancing the anchor (Fig. 7.41).

The stiffening wire (pos. 3) is removed from the internal catheter. About 60 ml of saline solution or 20% Gastrografin solution is injected into the catheter through the connector, so as to fill the EndoBarrier with fluid. Then, about 60 ml of air is injected through the same connector to separate the internal catheter from the tube. The internal catheter is removed from the exterior catheter, and under fluoroscopy it is observed whether the implant is puffed up backwards. The gastroscope and the outer catheter are then removed from the patient. The gastroscope is reintroduced, and the EndoBarrier is checked in the duodenal bulb: 60 ml of 20% Gastrografin solution is flushed into the EndoBarrier through the working canal of the gastroscope, to confirm that the product is passable and to smooth out the system's tube area (Fig. 7.42).

Explantation of the EndoBarrier: Personal-Related Requirements

Basically, the same requirements as in the case of implantation. The team must, however, be aware of the explantation being associated with more complications than the implantation.

Explantation of the EndoBarrier: Technical Requirements

EndoBarrier explantation system (Fig. 7.43), gastroscope with a working canal of 2.8 mm, fluoroscopy unit, 20 ml and 60 ml syringes and 200 ml of sterile saline solution

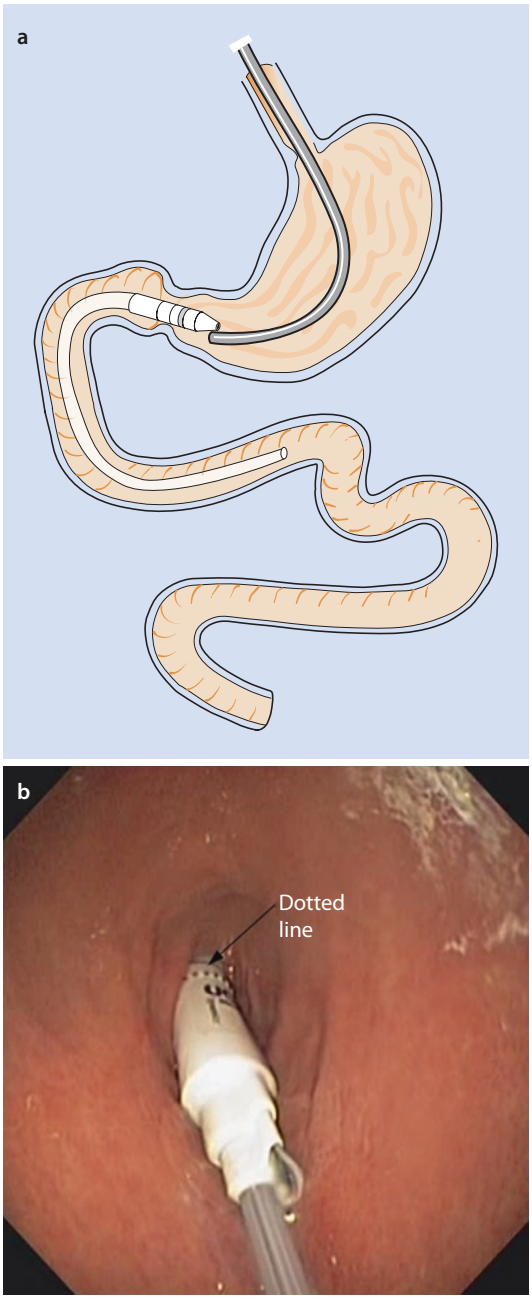

Fig. 7.40 **a**, **b** Release

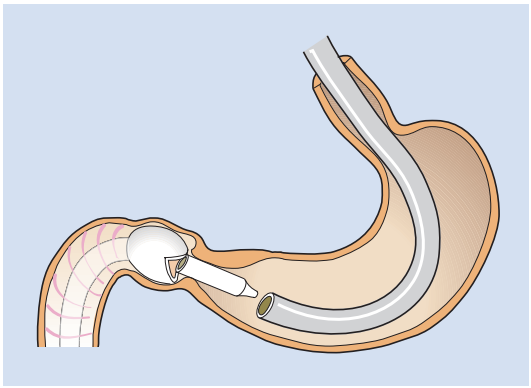

Fig. 7.41 Fixation of the system in the bulb

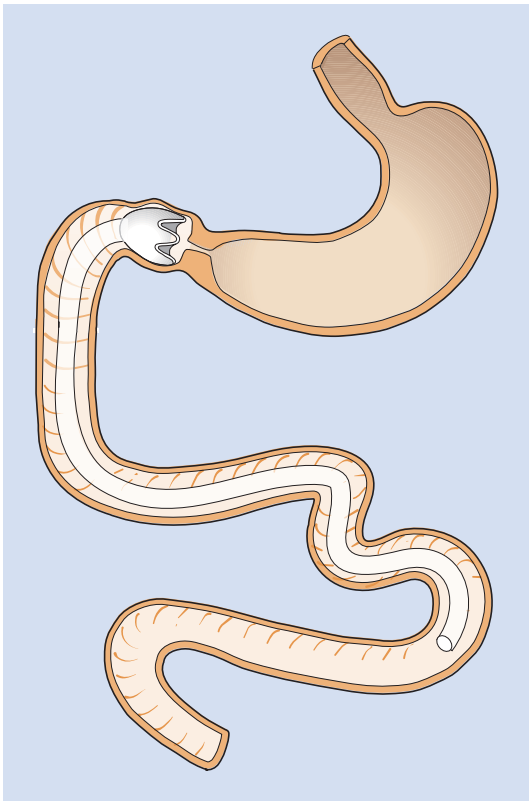

Fig. 7.42 System in situ

Explantation of the EndoBarrier: Practical Course

The patient is positioned on the left side and the gastroscope is introduced. If required, flush with saline solution, to be able to see the retrieval threads. The gastroscope is then removed, and the explantation cap is then attached to the tip of the gastroscope. Then, the gastroscope is introduced into the duodenum and placed so that the anchor and the retrieval threads are visible (Fig. 7.44).

The retrieval grasper (Fig. 7.44) is advanced through the gastroscope's working canal until it is positioned distally to the explantation cap. It must be ensured that the blocking at the retrieval grasper's handle is in non-blocked position. With the

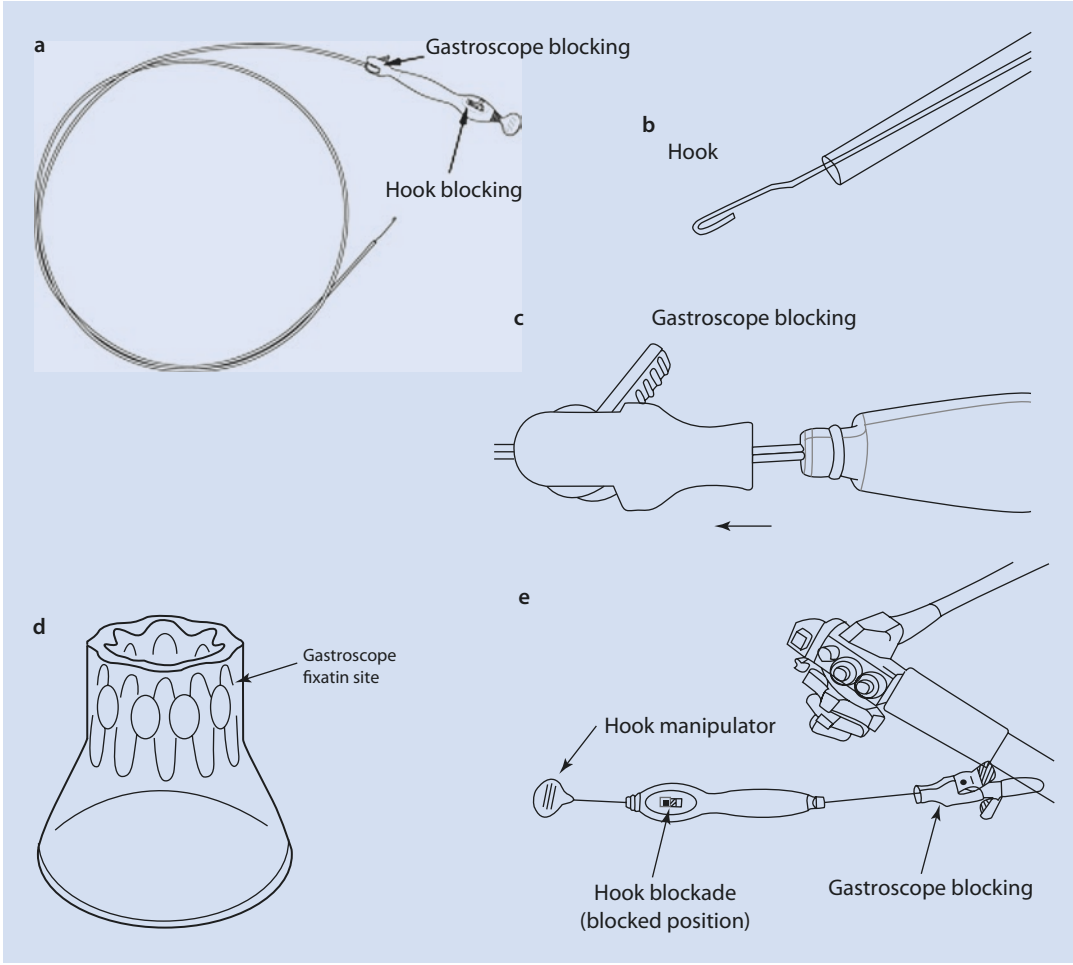

Fig. 7.43 **a–e** Explantation set (Courtesy of company GID)

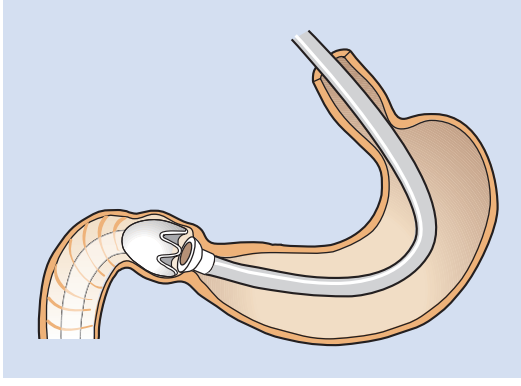

Fig. 7.44 Gastroscope in situ prior to explantation

help of the gastroscope, the grasper hook is then positioned around one of the retrieval threads. The grasper hook is pulled back with the handle, and the retrieval thread is therefore positioned into the inside of the sheathing. The sheathing with the partly retracted retrieval thread is then advanced so that the tip of the sheathing is located within the internal diameter of the implantation hook. The grasper with the endoscope is then placed in the middle of the anchor. The hook is slowly retracted, so as to completely compress the anchor. When doing this, it must be ensured that the endoscope and the cap are positioned proximally of the compressed anchor and are

free of the same. If the anchor is completely compressed, the hook blockage at the retrieval grasper's handle is put into blocked position to secure the compressed anchor. The grasper is held, and the explantation cap is moved over the proximal anchor hook, until it is enclosed in the explantation cap (Fig. 7.45). The compression of the anchor must be monitored under fluoroscopy to ensure that all hooks are enclosed in the cap.

The gastroscope blocking is then advanced distally from the end of the retrieval grasper's handle, until the endoscope is reached. The grasper is attached to the endoscope. The device enclosed in the cap is stopped in the stomach, and under fluoroscopic observation it is ensured with the endoscope that the cap is correctly enclosed in the cap (Fig. 7.46). Under fluoroscopic control, the gastroscope, retrieval grasper and implant are then pulled out while exerting slight traction.

In the end, the explantation site is endoscopically checked for haemorrhages. If required, flush with saline solution.

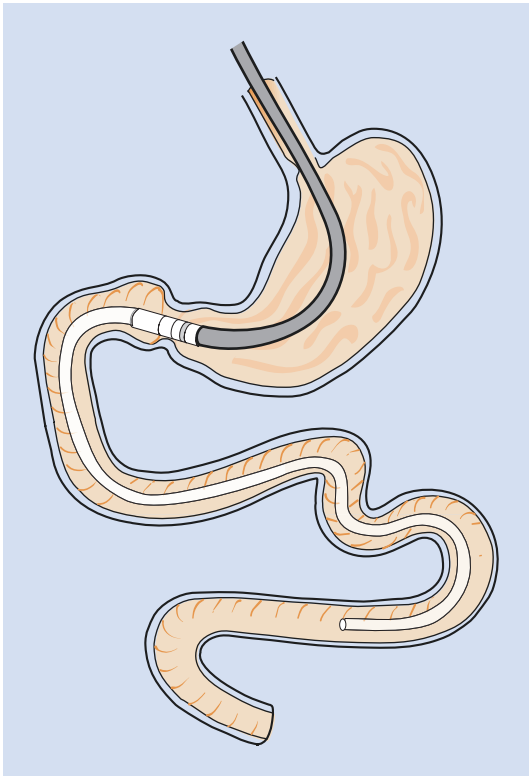

Fig. 7.45 Fixation

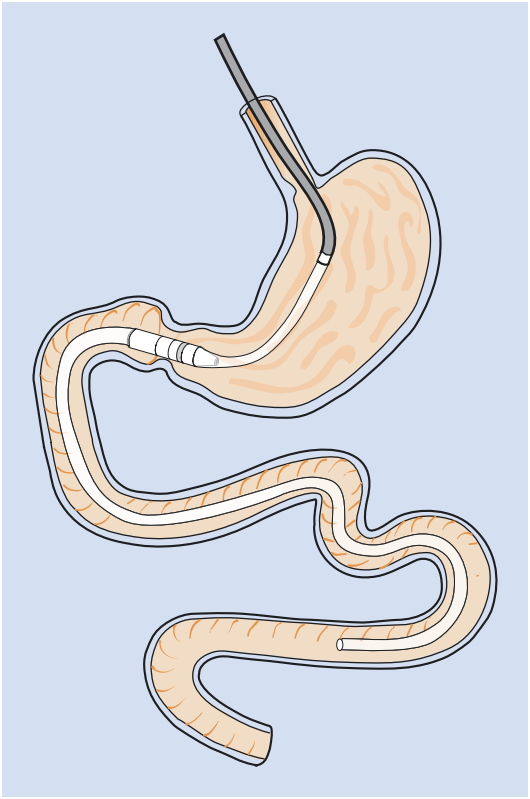

Fig. 7.46 Extraction

Possible complications during implantation and explantation:

- Laceration of the gastrointestinal tract
- Perforation of the oropharynx
- Perforation of the oesophagus
- Perforation of the stomach
- Bleeding
- Aspiration
- Infection

Possible complications during the implantation:

- Obstruction of the small intestines, migration of the EndoBarrier
- Erosion, bleeding
- Constipation, feeling of fullness, diarrhoea, flatulence
- Infection

- Hypo-/hyperglycaemia
- Gastrointestinal pain, cramps, nausea, vomiting
- Back pain
- Local, inflammatory tissue reaction
- Oesophagus, duodenitis, ulcer
- Perforation of the stomach or intestine
- Bezoar, GERF

Possible complications during and after the explantation:

- Laceration of the gastrointestinal tract
- Perforation of the oropharynx, oesophagus, stomach or intestines
- Bleeding
- Aspiration
- Infection

Complications

The few clinical studies revealed the following adverse events that occurred the most often:

- Nausea
- Vomiting
- Abdominal pain

Other improbable, but possibly occurring, risks can include:

- Infection
- Bleeding

Aftercare

During treatment, the patient must be accompanied, receive consultation and be cared for by a multidisciplinary medical team. This ensures that the patient's treatment plan is well coordinated and therapeutically effective. The following belongs to the team:

- Endoscopic specialist, metabolic surgeon or gastroenterologist
- General practitioner
- Endocrinologist and diabetologist
- Nutritional team

The members of the multidisciplinary team must always consult each other and exchange information regarding the patient's clinical and general state of health. The following needs to be discussed:

- Individual objectives regarding weight loss – depending on the patient's weight at the time of implantation
- Objectives regarding the improvement of diabetes based on the monitoring of the blood glucose levels and regularly performed HbA1c tests

Medication at Type II Diabetes Mellitus

Soon after the placement of the EndoBarrier, patients with type II diabetes detect a rapid improvement of the glycaemic control and their HbA1c levels. It is therefore recommended to adapt the TIIDM medication correspondingly at the time of implantation. Based on clinical studies, the following reductions were performed:

Sulfonyl Urea At the time of implantation, the dose of sulfonyl urea must be reduced by 50% so as to avoid possible hypoglycaemic episodes. Should a hypoglycaemic episode occur, an additional reduction by another 50% or discontinuation of the same is recommended, if the patient is already taking the lowest dose possible.

Insulin At the time of implantation, the insulin dose must be reduced by 50% so as to avoid possible hypoglycaemic episodes. Should a hypoglycaemic episode occur, an additional reduction by another 50% or discontinuation of the same is recommended, if the patient is already taking the lowest dose possible.

Metformin During the entire treatment duration, the metformin dose can remain unchanged, unless the sulfonyl urea and/or the insulin has already been discontinued and the patient's fasting glucose levels on 3 consecutive days are below 4 mmol/l. In this case, the metformin dose must be reduced by 50%. If the patient still experiences cases of hypoglycaemia after this reduction, it is up to the physician to change the metformin dose again or to suspend it completely.

After these initial reductions, the endocrinologist/diabetologist can change the type II diabetes medication according to the standard algorithm and based on the glucose levels and symptoms.

Recommendations Regarding Diet and Nutrition

The EndoBarrier is supposed to facilitate a healthy and nutritious diet. The treatment success, however, depends on the patient's willingness to adopt healthier eating and lifestyle habits. The patients must adhere to a diet immediately after the implantation, which is similar to that recommended to other bariatric procedures. At the beginning, this diet does, however, also encompass liquid foods, followed by a diet with pureed foods.

General recommendations for the first 2 weeks after implantation of the EndoBarrier:

Days 1–7

- Clear or artificially sweetened fluids
- Salty fluids
- Clear broth
- Sugar-free popsicles
- Fluids with solid parts including:
  - Fat-free milk, mixed with whey or soy protein powder (max. of 20 g of protein per portion)
  - Lactose-free milk
  - Soy milk mixed with soy protein powder
  - Low-fat yogurt, mixed
  - Simple low-fat yogurt
  - Greek yogurt

Days 8–14

- Increase clear fluids by 1.5–2.0 l per day.
- Substitute fluids containing solids by moist, diced or pureed protein sources, depending on how they are tolerated.

After 14 days, the patients can change to solids, as recommended by a dietician.

References

Bernhardt J (2007) Sondentechniken. In: Kahl S, Kähler G, Dormann A (Hrsg) Interventionel le Endoskopie. Elevier, München S 347–350

Dormann AJ, Deppe H. Tube feeding – who, how and when. Z Gastroenterol. 2002;40:S8–S14.

Dormann AJ, Wigginghaus B, Grünewald T, Huchzermeyer H. Erste Erfahrungen mit dem Freka®-Button. Endoskopie heute. 1998;11:19–22.

Dormann AJ, Wigginghaus B, Risius H, Kleimann R, Kloppenburg A, Huchzermeyer H. A single dose of ceftriaxone administered 30 minutes before percutaneous endoscopic gastrostomy (PEG) significantly reduces local and systemic infective complications. Am J Gastroenterol. 1999;94:3220–4.

Gauderer MWL, Picha GZ, Izant GJ. The gastrostomy «button» – a simple, skin-level, nonrefluxing device for long-term enteral feeding. J Pediatr Surg. 1984;19:803–5.

Külling D, Bauerfeind P, Fried M. Transnasal versus transoral endoscopy for placement of nasoenteral feeding tubes in critically ill patients. Gastrointest Endosoc. 2000;52:506–10.

Müller-Gerbes D, Aymaz S, Dormann AJ. Management of the buried bumper syndrome: a new minimally invasive technique – the push method. Z Gastroenterol. 2009;47:1145–8. doi:10.1055/s-2008-1027988.

Oehmichen F, et al. Leitlinie der Deutschen Gesellschaft für Ernährungsmedizin (DGEM). Ethische und rechtliche Aspekte der künstlichen Ernährung. Akt Ernährungsmed. 2013;38:112–7.

Ponsky JL. Transilluminating percutaneous endoscopic gastrostomy. Endoscopy. 1996;30:656.

Romero R, Martinez FL, Robinson SYJ, Sullivan KM, Hart MH. Complicated PEG-to-skin level gastrostomy conversions: analysis of risk factors for tract disruption. Gastrointest Endosc. 1996;44:230–4.

Russel TR, Brotman M, Norris F. Percutaneous gastrostomy: a new simplified and cost-effective technique. Am J Surg. 1984;148:132–7.