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GB 2552924 B

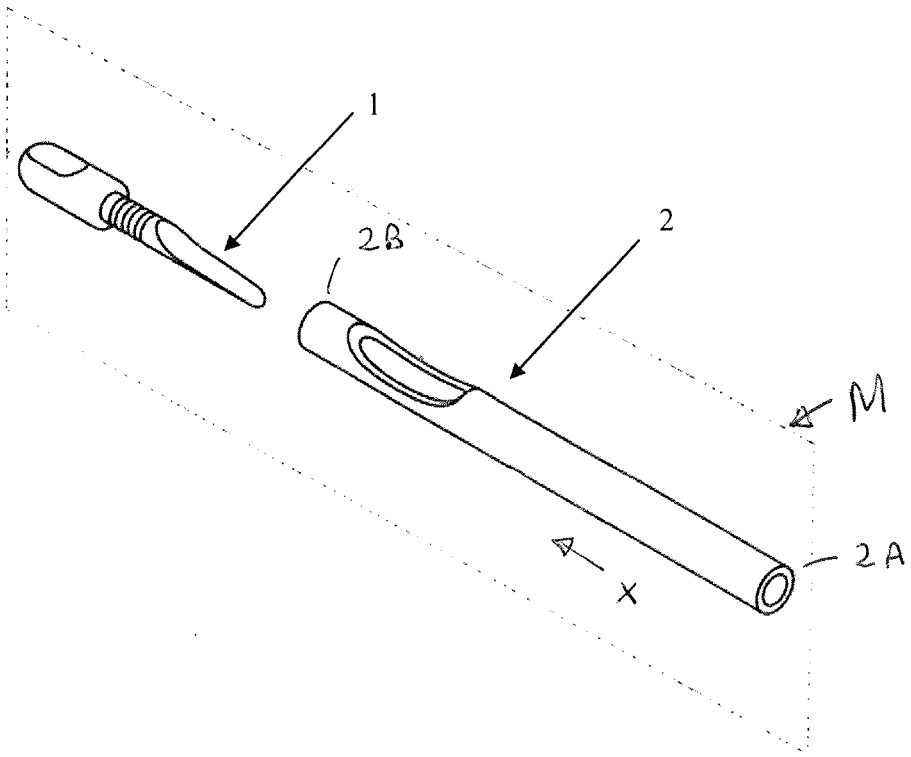

Figure 1

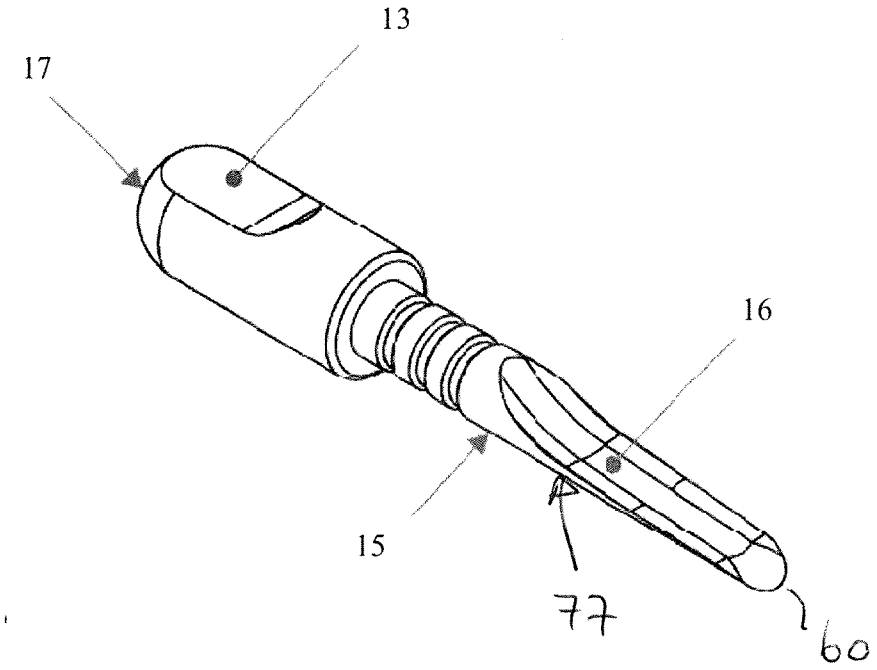

Figure 2

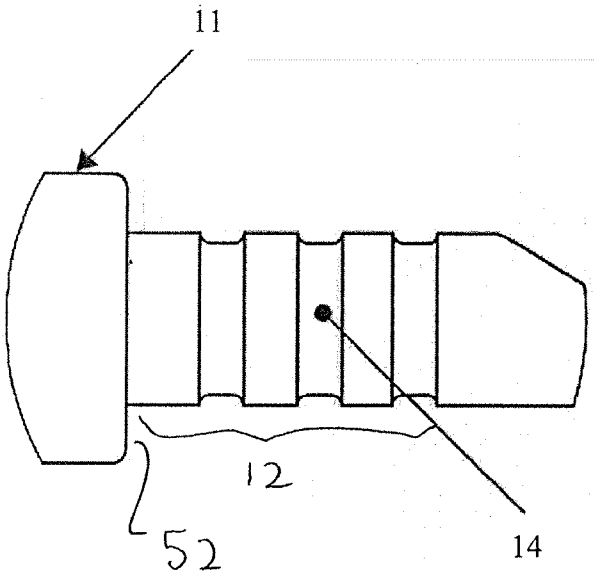

Figure 3

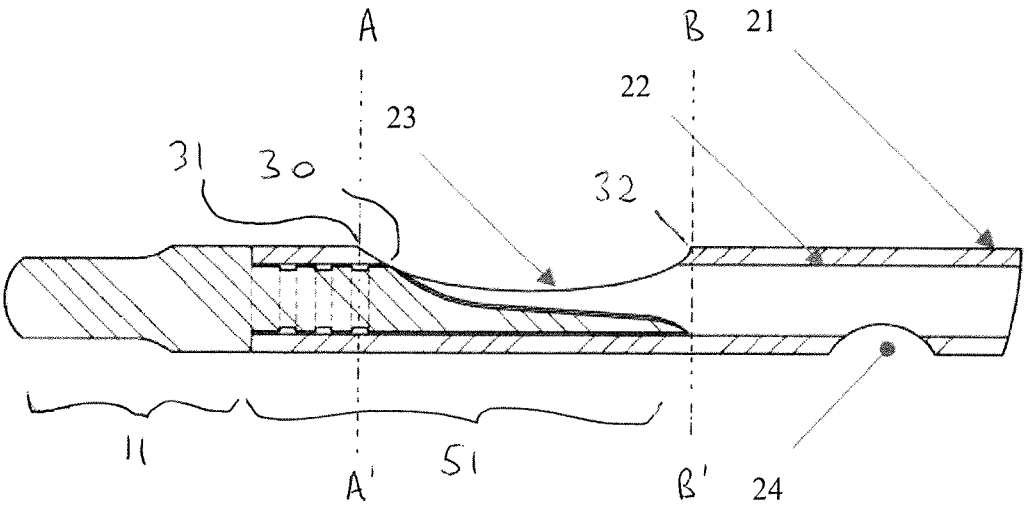

Figure 4

Feeding Tube

The present invention relates to a feeding tube (*eg* a catheter).

Adequate nutrition and medication are of key importance in patient recovery. In patients who are unable to swallow or take adequate nutrition or medication orally, a nasogastric or nasojejunal feeding tube is often used to deliver nutrients or medication directly into the gastrointestinal tract. Enteral feeding has few complications and is low cost compared with parenteral nutrition which is associated with a high complication rate and high cost.

If the patient has a functioning gastrointestinal tract, the feeding tube is inserted through the nose into the stomach or small intestine via the pharynx and oesophagus. Correct positioning of the feeding tube is verified by aspirating gastric juice which is tested using pH paper. The patient can then receive nutrition via the feeding tube.

Known nasogastric or nasojejunal feeding tubes feature a fluid outlet on both sidewalls close to the tip or an open ended tip. Feeding tubes with a fluid outlet on both sidewalls have a rounded tip to aid intubation but they are more likely to block when granulated medication is given. Feeding tubes with an open ended tip can be passed over a guidewire but do not generally incorporate a rounded atraumatic tip of the type seen in closed ended nasogastric tubes. Enlarged holes may alleviate the tendency for blockage but weaken the stability of the tube and lead to kinking.

Another known feeding tube has an outlet port in a rigid bolus which is larger than the French gauge of the feeding tube (see for example US-A-6511474). The rigidity of the bolus increases the risk of lung puncture during placement. The feeding tube has only one outlet which may get sucked onto the internal abdominal wall during aspiration of gastric juice and which therefore makes it difficult to confirm correct positioning. The outlet port is wider than the actual feeding tube which makes it more uncomfortable to place and causes a safety concern when used with securing devices such as a Corgrip™ or Nasal Bridle™.

The present invention seeks to improve the performance of a feeding tube by judicious configuration and relative positioning of a bolus and French tube.

Thus viewed from a first aspect the present invention provides a feeding tube for enteral nutrition or medication of a subject comprising (or consisting essentially of *eg* consisting of):

a French tube having a bore for delivering nutrients or a medicament from an upstream end positioned *ex vivo* towards a downstream end positioned *in vivo*, wherein the bore includes an anterior main port adjacent to the downstream end for discharging the nutrients or medicament and a posterior secondary port which is upstream from the main port; and

a rigid bolus partially mounted in the French tube, wherein the bolus includes an exterior shaft with a proximal end which circumferentially abuts the downstream end of the French tube and an elongate shank extending axially from the proximal end and tapering across the axial span of the main port to a distal end.

If in the feeding tube according to the invention, the downstream main port becomes blocked, the secondary port is likely to be clear to allow the feeding tube to continue to discharge feed. Having the secondary port axially offset (upstream) from the main port serves to prevent kinking under axial compression (*eg* during intubation).

The feeding tube may be a nasogastric or nasojejunal feeding tube.

Preferably the elongate shank tapers decreasingly towards the distal end. For example, the elongate shank may taper precipitously in a first portion and gradually in a second portion. The elongate shank may taper precipitously in a third portion at the distal tip.

The decreasing taper of the supporting rib towards its distal end provides a steepening incline which guides the nutrients or medicament unobstructed towards the main port for free-flowing discharge with minimal resistance.

Preferably the supporting rib has an at least partially (preferably wholly) concave anterior face.

Preferably the supporting rib has an at least partially (preferably wholly) convex posterior face.

In a preferred embodiment, the elongate shank is configured to form a cylindrical boss portion which extends into a supporting rib narrowing progressively towards the distal end.

Preferably the supporting rib narrows progressively in the anterior to posterior direction towards the distal end.

The cylindrical boss portion is typically mounted snugly in the bore at the downstream end of the French tube.

Preferably an axial extremity of the cylindrical boss portion is adjacent upstream to the transverse plane occupied by a downstream extremity of the perimeter of the main port.

By virtue of this positioning of the cylindrical boss portion, there is no void downstream from the main port which might otherwise harbour nutrients or medicament and/or lead to infection.

Preferably the distal end of the supporting rib is adjacent downstream to the transverse plane occupied by an upstream extremity of the perimeter of the main port.

The positioning of the supporting rib serves to ensure that there is no reduction in the effective internal diameter of the French tube or restriction of the feed volume.

Preferably the supporting rib is cut-away to form an anterior dished surface that substantially spans the axial diameter of the main port between the downstream extremity of the perimeter and the upstream extremity of the perimeter. The anterior dished surface may be concave.

The main port may be round or elliptical and may be dished. The secondary port may be round or elliptical and may be dished.

A distal tip of the exterior shaft may be smooth and rounded. This serves to prevent internal snagging and discomfort for the patient during intubation.

Preferably adjacent to the distal tip of the exterior shaft are opposing anterior and posterior substantially planar faces.

The opposing anterior and posterior substantially planar faces advantageously act as a datum for the supporting rib to be positioned accurately relative to the main port. Measuring equipment can be positioned on the substantially planar faces to check tolerances during quality control.

The French tube and bolus are typically secured by adhesive. The outer surface of the elongate shank may feature one or more recesses which act as adhesive reservoirs and increase the surface area for bonding. The cylindrical boss portion may be circumferentially recessed.

The present invention will now be described in a non-limitative sense with reference to the accompanying Figures in which:

Figure 1 illustrates the disassembled parts of an embodiment of the feeding tube of the invention in perspective view;

Figure 2 illustrates the bolus of the embodiment of the feeding tube of the invention in perspective view;

Figure 3 illustrates a part of the bolus of the embodiment of the feeding tube of the invention; and

Figure 4 illustrates the embodiment of the feeding tube of the invention in cross-section.

Figures 1 to 4 illustrate an embodiment of the feeding tube of the invention. The feeding tube comprises a French tube (2) for delivering feed from an upstream end (2A) towards a downstream end (2B) in direction X and a rigid moulded bolus (1) received in the downstream end (2B). A support wire (not shown) is used during intubation to prevent kinking of the French tube (2) and to help to guide the bolus (1).

The French tube (2) is elongate and cylindrical with an outer wall (21) and an inner wall (22) enclosing a bore. The French tube (2) comprises an anterior main port (23) for discharging feed and a posterior secondary port (24) which is upstream from the main port (23). The main port (23) and secondary port (24) are bisected by the median plane (M in Figure 1). The secondary port (24) is smaller than the main port (23) and barely breaches the inner wall (22). This ensures that there is minimal structural impact on the French tube (2)

and mitigates the risk of the support wire (not shown) exiting the French tube (2) prematurely.

The bolus (1) consists of an exterior shaft (11) with a proximal end (52) which circumferentially abuts the downstream end (2B) of the French tube (2) and an elongate shank (51) extending axially from the proximal end (52). The diameter of the exterior shaft (11) and the diameter of the outer wall (21) of the French tube (2) are the same so that the feeding tube has a continuous exterior profile. This serves to prevent internal snagging and discomfort for the patient during intubation.

The elongate shank (51) is shaped to form a cylindrical boss portion (12) which is circumferentially recessed and which extends into a supporting rib (15) narrowing progressively towards a distal end (60). The cylindrical boss portion (12) is configured to locate snugly in the bore at the downstream end (2B) of the French tube (2) at a position at which its axial extremity (30) is just beyond the transverse plane AA' occupied by the downstream extremity (31) of the perimeter of the main port (23). The distal end (60) of the supporting rib (15) is positioned just short of the transverse plane BB' occupied by the upstream extremity (32) of the perimeter of the main port (23). This positioning of the supporting rib (15) serves to ensure that there is no reduction in the diameter of the internal wall (22) or restriction of the feed volume.

The supporting rib (15) is cut-away to form an anterior dished surface (16) that substantially spans the axial diameter of the main port (23) between the downstream extremity (31) and the upstream extremity (32). This feature coupled with the progressive narrowing of the supporting rib (15) towards its distal end (60) provides a gradually steepening incline which guides feed unobstructed towards the main port (23) for free-flowing discharge with minimal resistance. The anterior dished surface (16) is laterally concave along its length. The opposing posterior surface (77) is convex.

A distal tip (17) of the exterior shaft (11) of the bolus (1) is smooth and rounded to prevent internal snagging and discomfort for the patient during intubation. Adjacent to the distal tip (17) are opposing anterior and posterior flat faces (13) which act advantageously as a datum for the supporting rib (15) to be positioned accurately relative to the main port (23) as described above. The flat faces (13) are bisected by and perpendicular to the median

plane (M in Figure 1). Measuring equipment can be positioned on the flat faces (13) to check tolerances during quality control.

The French tube (2) and bolus (1) are secured by an adhesive which provides a gap-free joint between the outer surface of the cylindrical boss portion (12) and the inner wall (22) of the French tube (2). The outer surface of the cylindrical boss portion (12) features three recesses (14) which act as adhesive reservoirs and increase the surface area for bonding. Adhesive is applied along the length of the supporting rib (15) to the distal end (60). This provides support and resistance to kinking across the main port (23) of the French tube (2) in what would otherwise be the weakest part of the feeding tube.

CLAIMS

1. A feeding tube for enteral nutrition or medication of a subject comprising:

a French tube having a bore for delivering nutrients or a medicament from an upstream end positioned *ex vivo* towards a downstream end positioned *in vivo*, wherein the bore includes an anterior main port adjacent to the downstream end for discharging the nutrients or medicament and a posterior secondary port which is upstream from the main port; and

a rigid bolus partially mounted in the French tube, wherein the bolus includes an exterior shaft with a proximal end which circumferentially abuts the downstream end of the French tube and an elongate shank extending axially from the proximal end and tapering across the axial span of the main port to a distal end.

2. A feeding tube as claimed in claim 1 wherein the elongate shank tapers decreasingly towards the distal end.

3. A feeding tube as claimed in claim 1 or 2 wherein the elongate shank tapers precipitously in a first portion and gradually in a second portion.

4. A feeding tube as claimed in claim 3 wherein the elongate shank tapers precipitously in a third portion at the distal tip.

5. A feeding tube as claimed in any preceding claim wherein the elongate shank is configured to form a cylindrical boss portion which extends into a supporting rib narrowing progressively towards the distal end.

6. A feeding tube as claimed in any preceding claim wherein the supporting rib narrows progressively in the anterior to posterior direction towards the distal end.

7. A feeding tube as claimed in any preceding claim wherein an axial extremity of the cylindrical boss portion is adjacent upstream to the transverse plane occupied by a downstream extremity of the perimeter of the main port.

8. A feeding tube as claimed in any preceding claim wherein the distal end of the supporting rib is adjacent downstream to the transverse plane occupied by an upstream extremity of the perimeter of the main port.

9. A feeding tube as claimed in any preceding claim wherein the supporting rib is cut-away to form an anterior dished surface that substantially spans the axial diameter of the main port between a downstream extremity of the perimeter and an upstream extremity of the perimeter.

10. A feeding tube as claimed in any preceding claim wherein adjacent to the distal tip of the exterior shaft are opposing anterior and posterior substantially planar faces.