# Construction and insertion of oesophageal cannulae for use in domestic ruminants

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## ABSTRACT

The design of an oesophageal cannula for goats, sheep and cattle is described. The cannula consists of a base, threaded bar and stopper made of polyvinyl chloride (PVC) or wood. The surgical procedure in goats for inserting the cannula is described as well as how to keep the wound around the cannula clean.


**Keywords**: cattle, construction of cannulae, fistula, goats, sheep.

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## INTRODUCTION

When studying the grazing habits and diet selection of ruminants it is often useful to use oesophageal cannulae for the collection of plant material that has been consumed by the animal[2,9]. A technique using surgically constructed fistulae with specialised cannulae was developed during the 1950s[15]. At that time it was used to determine the diet preference of goats in order to pinpoint the type of locality in which they would thrive[3,14]. A similar method has also been used to evaluate diet quality and measure intake[1,10]. Subsequently, the shape of the cannula was improved and different materials were used for its construction, but improvements did not result in an ideal cannula[4,,8,16]. A later adaptation included a remote-controlled system which allowed the cannula to be opened and closed as required[12].

The size of the cannula is also important for the efficient collection of material[5,6]. The ideal aperture size of the fistula was described as 600 $mm^2$, but an area of 1060 $mm^2$ was later found to better accommodate the remote-controlled unit[11,12]. This aperture size was found to work well with a cannula sleeve (or base) of 97 × 20 mm[13]. Our investigations confirmed that a sleeve of 20 mm diameter is best for the manual collection of samples from sheep and goats, but that the length should be increased 97 mm to 110 mm. The shorter base does not adequately support the larger stoppers and tends to fall out of the fistula in cattle.

As there are no standard sizes of cannulae, their commercial manufacture for research purposes becomes difficult[6,7]. For this reason it was decided to publish details on cannula dimensions for different animals, as well as modern surgical techniques for the insertion of the cannulae. A standard profiled, easily constructed cannula, together with instructions for its surgical insertion, would make the work of both veterinarians and researchers much easier.

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## DESCRIPTION OF TECHNIQUE

### Construction of cannula

The cannula consists of a sleeve or base 110 mm long, 20 mm wide and about 2 mm in thickness, cut lengthwise from a normal PVC drain pipe (used in all household sanitary constructions). The 2 ends of the sleeve were rounded on a sanding disk and all sharp edges were removed with a 200 grit sandpaper. The convex side of the PVC sleeve was covered with a piece of bicycle tube. The concave side of the bicycle tube was glued to the convex side of the PVC sleeve allowing 2–3 mm of tube to overhang the PVC (Fig. 1). This flexible edge protects the oesophagus while also sealing the fistula from the lumen. The sleeve was difficult to insert when the convex side of the bicycle tube was attached to the convex side of the PVC as described previously[13].

Two 2 mm holes were drilled through the centre of the sleeve approximately 5 mm apart in order to house the 2 ends of a 2 mm brazing rod which attaches a brass threaded bar 5 mm in diameter and 50 mm long (Fig. 2) to the sleeve. One end of the brass rod was flattened and a hole 3 mm in diameter was drilled through this

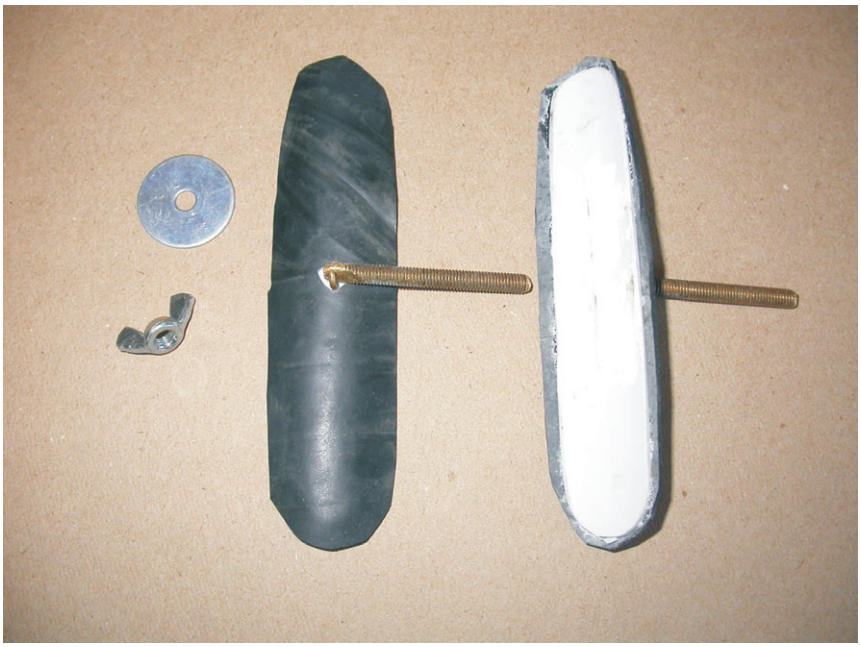

Fig. 1: **The sleeve or base of the oesophageal cannula with tube flange overhanging the PVC.**

area. The 2 mm brazing rod was bent and threaded through the hole, allowing the threaded bar to have a lengthwise swivel action. The 2 ends of the brazing rod were inserted through the 2 holes of the sleeve and the ends bent flat against the concave side of the sleeve and glued to the surface with Pratley® Quickset Glue (Pratley (Pty) Ltd, South Africa) (Fig. 3).

The plugs or stoppers used to close the fistula and secure the sleeve were made from moulded nylon. They were solid with a central hole (Fig. 4) to accommodate the threaded bar and secured with a wing nut. In a previous design a hollow plug was used for this purpose[13], but we found this did not attach securely and was difficult to fasten with the wing nut. The smallest stopper had a concave base 30 mm long and 20 mm wide which fitted over the round part of the PVC pipe. This stopper was 25 mm high and widened from the base to 40 mm in diameter at the top. The outer (upper) surface bore a 50 mm flange (Fig. 5). The length of the stoppers was increased by 15 mm each time so that the next size was, for example, 45 mm at the base, widening to 55 mm with a rim 65 mm. These sets were only used in animals which were to be fitted with the remote collection device where the final fistula size was considerably larger than the original fistula.

For the standard oesophageal fistula used in sheep and goats a single wooden stopper (50 mm long, with a base of 35 mm and outer circumference of 45 mm) was used (Fig. 5). For cattle (Fig. 4 on the right) the length of the sleeve or base is 130 mm and the width is 35 mm, with a round wooden stopper (base 35 mm, widening to 55 mm, height 60 mm). In this case the threaded bar was 6 mm in diameter and 90 mm long and the brazing rod was 3 mm in diameter (Fig. 5). These cannulae are removed when collection bags are attached or sampling done directly from the oesophagus.

### Surgical placement

In the description of the surgical approach, brand names are not given, as different brands will be used by different practitioners. Prior to anaesthetic induction, goats are pre-medicated with 0.5 mℓ of atropine (10 mg/mℓ) intramuscularly to reduce saliva secretion and 2 mℓ diazepam given intravenously to sedate them. The left side of the neck is shaved and cleaned with hibitane. A local anaesthetic, lignocaine 2 % is injected subcutaneously and anaesthesia is induced with 2–3 mℓ of ketamine intravenously.

The animal is positioned on in right lateral recumbancy on an operating table. A 1-metre length of high-pressure poly-

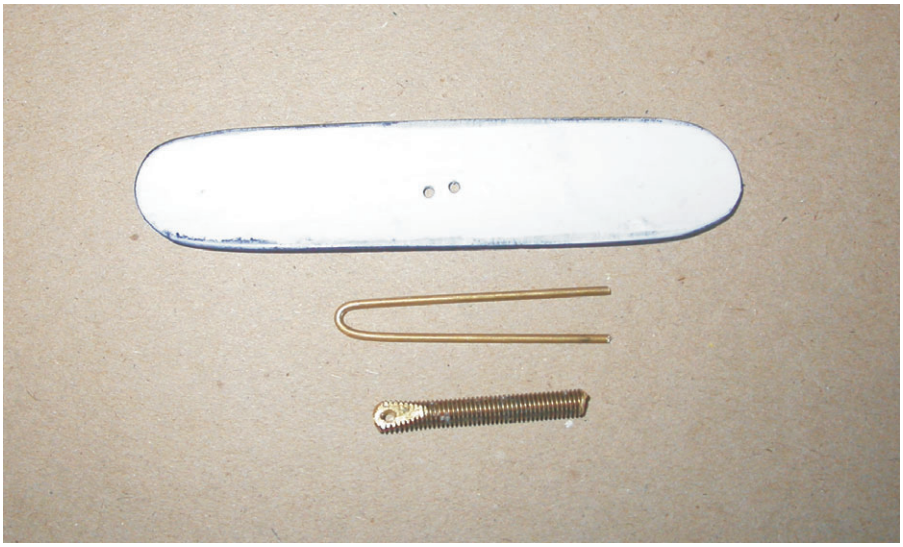

Fig. 2: **Concave side of the sleeve with the brass rod and attaching pin.**

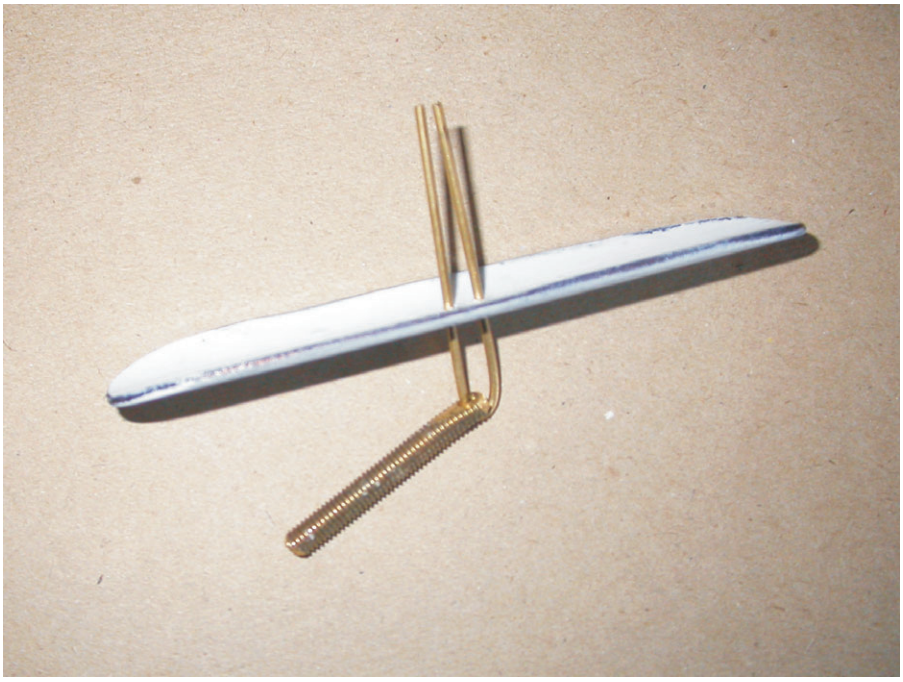

Fig. 3: **Insertion of the pin and brass rod to the sleeve of the cannula.**

Fig. 4: **Different sizes of solid stoppers used to secure the cannula sleeve.**

cop hose (see Fig. 6) with a 15 mm diameter (1 end slightly rounded with sandpaper so as not to damage the oesophageal mucosa) is inserted into the oesophagus. It should be positioned with the tip about halfway down the neck and then pushed downwards and towards the left side of the neck so that the tip indicates the spot where the incision should be made (Fig. 7). Care must be taken that the jugular vein is positioned below or to the side of the oesophagus before the incision is made.

A single cut about 10 mm longer than the stopper of the cannula is made on the spot defined by the tip of the polycop pipe. The depth of the incision into the lumen of the oesophagus is ensured by the presence of the polycop pipe within the lumen (Fig. 8). The oesophageal wall and the overlying muscle and skin layers are sutured using soluble suture material. At this stage it is important that the mattress suturing is not continuous around the incision, but that the top and bottom halves are sutured separately to prevent excessive tension on the aperture and the skin. The sleeve (or base, Fig. 1) of the cannula is inserted into the oesophagus and the plug or stopper placed in position to fill the opening into the oesophagus (Fig. 9). This newly-formed fistula is maintained by the presence of the stopper which is held in place by a wing nut. The wing nut should not be over-tightened.

Fistula care should start 3–4 days after surgery and should be performed every 2nd day. The entire cannula is removed from the fistula and both the cannula and fistula are cleaned using hibitane. These are carefully replaced after cleaning the fistula with hibitane. Should the fistula need stretching to a larger final size, this can be done after the stitches have dissolved or at 10 days after surgery. Thereafter a progressively larger stopper may be inserted every 7–10 days until the final size is reached.

## DISCUSSION

The usefulness of cannulae has been demonstrated in a number of research projects. Over a period of 4 years oesophageal cannulae have been placed in sheep, goats and cattle for research purposes at an agricultural research facility in Limpopo Province and at both the Faculty of Veterinary Science and the Faculty of Agricultural and Biological Sciences of the University of Pretoria. Oesophageal cannulae of this design were placed in cattle in Namibia and used to determine plant selection, while goats fitted with cannulae and remote collection devices were used in a study in the Eastern Cape to determine diet selection and diurnal feeding habits. All projects in which animals were fitted with cannulae were approved by the Ethics Committee of the University of Pretoria. The results from these studies are being used for post-graduate degrees. To date no problems have been encountered with the functionality of the cannulae. At present, there is no demand for the commercial manufacture of these cannulae and all are made privately.

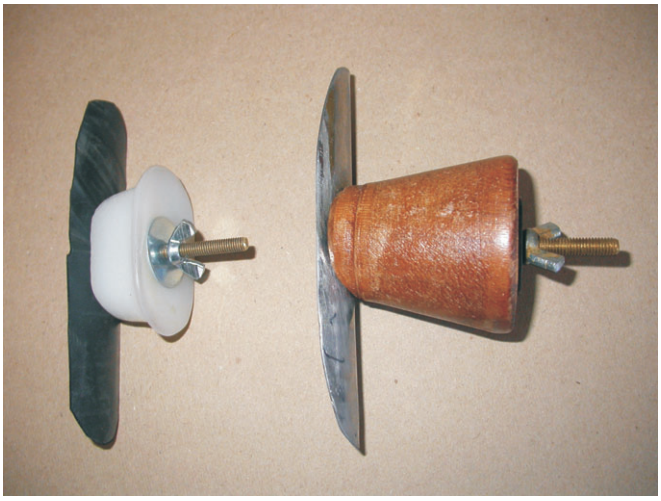

Fig. 5: **Two different cannula formats. The left one is used to stretch the fistula for the insertion of a remote collection device while the one on the right is a standard oesophageal cannula.**

Fig. 6: **The polycop pipe on the right and a broomstick for cattle on the left.**

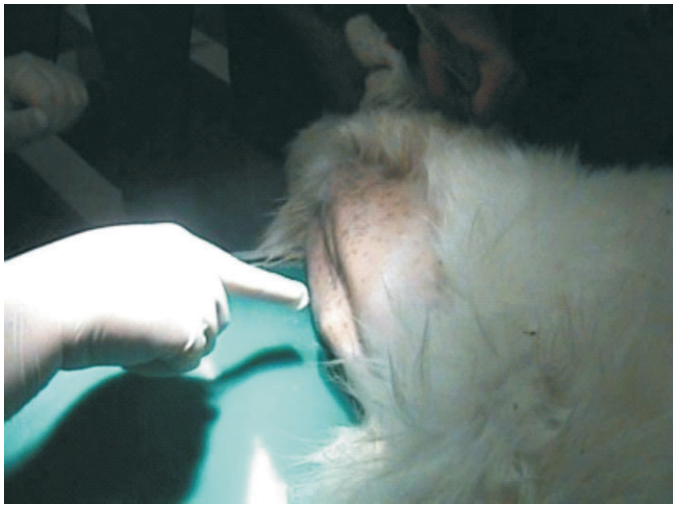

Fig.7: **Site for incision on the neck of the goat indicated by the tip of the polycop pipe**.

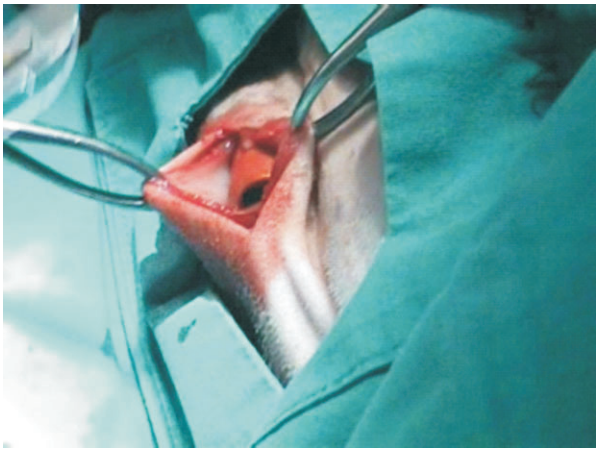

Fig. 8: **Incision showing the tip of the polycop pipe.**

Fig. 9: **Stopper in place in the fistula. The jugular vein of the goat is to the right of the stopper**.

Fig. 10: **Oesophageal cannula in place**.

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