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OBSERVATIONS ON A NEW METHOD OF CANALIZING STRICTURES OF THE OESOPHAGUS

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A great deal has been written about the treatment of oesophageal strictures. It is, therefore, not my intention to review the methods in use today or to assess the end-results obtained with different methods of treatment. Different clinics still have their individual preferences, which makes it clear that no single method appears to be entirely satisfactory. During the past two years a new procedure has been attempted for the treatment of cases with both benign and malignant strictures admitted to our wards. This procedure is briefly described in this paper.

Benign Strictures

The commonest cause of benign strictures of the oesophagus is ingestion of corrosive substances. The prevalence of this condition in South Africa and the relevant problems of treatment have been most adequately stressed by Marchand. Every worker in the field of corrosive strictures of the oesophagus has had to face the problem of tragedy in accidental cases. Moreover, a heavy demand is placed on the surgeon, the anaesthetist, the relatives and on the accommodating institution alike, by the inevitably long-drawn.out process of treatment. It is the distressing picture of the mature, established, and often impermeable stricture which has stimulated this new approach.

Established strictures have been approached universally with the bougie, and most authorities still agree that, at this stage, conservative dilatation should be attempted in all cases, in spite of the accessibility of the stricture to modern surgery. All endoscopists undertaking this treatment have been pleased to find a lumen in the bad stricture, whether by retrograde bouginage by the Iglauer method, by anterograde filiform bouginage, or by the swallowing of thread; but they have been as disappointed at the subsequent endoscopy by the elusiveness of the tiny lumen. It has been equally disappointing to find, in a stricture with a reasonable lumen, that the maximal dilatation achieved at the previous session has not been maintained.

Attempts have been made in Scandinavia to maintain the lumen by permanent canalization with a rubber feeding tube introduced through a lateral pharyngotomy. This procedure was, however, not continued for obvious reasons.

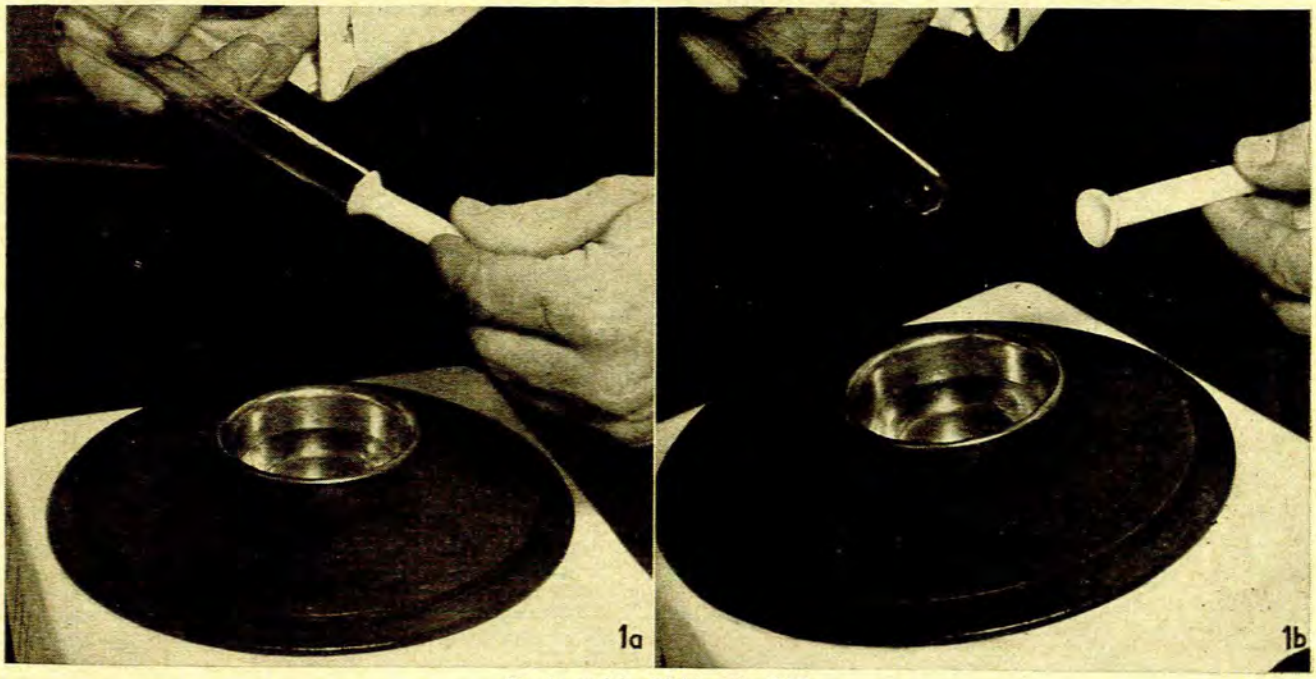
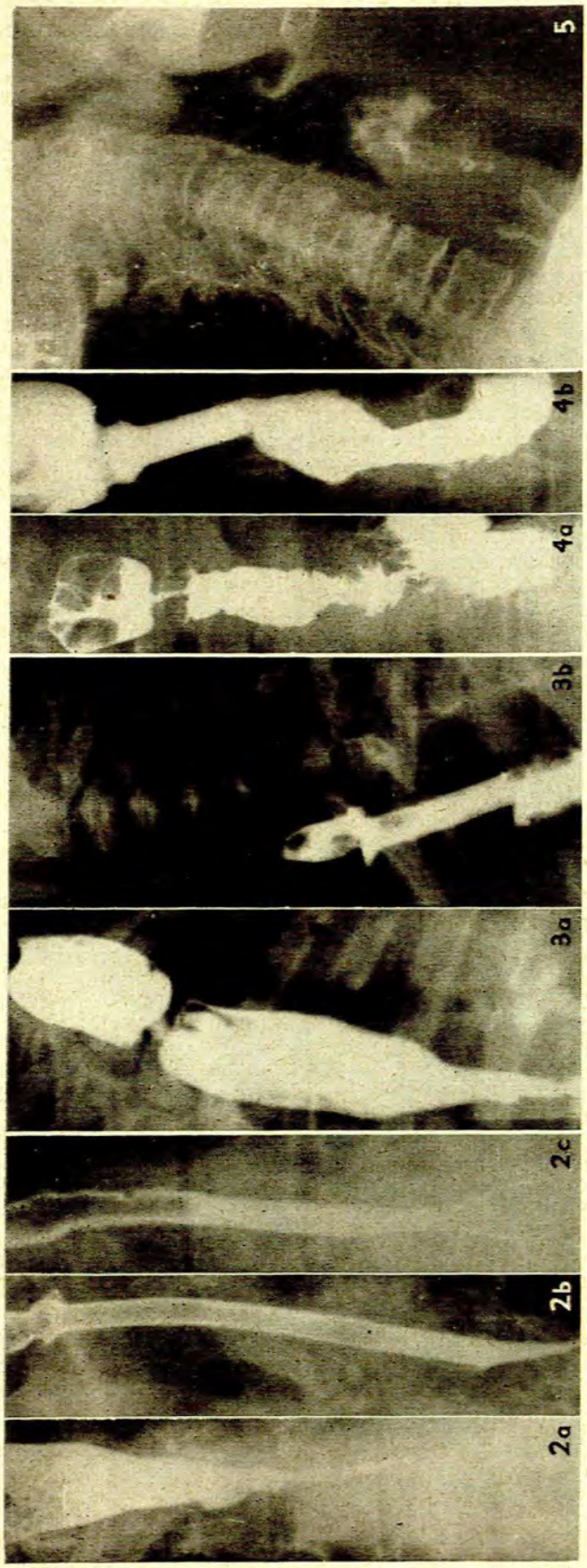


Fig. 1*a* and *b*. Making the FPT.



A number of cases are described here to show the results obtained with permanent canalization by means of a flanged portex tube (FPT) made out of ordinary endotracheal tubes (without the knowledge of the Anaesthetic Department !).

MAKING THE FPT

The end of an ordinary endotracheal portex tube is heated in glycerine at a temperature of 200 - 215°F. Simultaneously, the bottom of a glass test-tube, of a size according to the flange required, is heated for a few seconds in the same container. The portex tube and the test-tube are then both quickly removed from the glycerine and the bottom of the test-tube is immediately transferred to the open heated-end of the portex tube which is then, by slight pressure of the test-tube, moulded to the required size. Within 10 - 20 seconds the test-tube and the portex have cooled (they may be separated under running water) and when the test-tube is removed, the flange on the portex tube is maintained. This flange will remain even after boiling.

The prepared tube may then be cut to the desired length with scissors before or during the endoscopy. The tubes used in this series were all made in a gallipot on a hot-plate in the tea-room outside the theatre, quite quickly and simply (Figs. 1*a* and *b*). Repeated boiling tends to soften portex and this is overcome, if necessary, by soaking the tube, or part of it, in commercial ether for a period of 5-7 minutes, and then leaving it to dry for 36 hours. Soaking for longer periods can make the tube absolutely rigid. Many of the flanges, and some of the smaller sized tubes used in this series, were made firm by soaking them in ether for 6 minutes. Tubes used for carcinomatous strictures were soaked slightly longer.

Method of Insertion

In this series the Negus oesophagoscopes were used as a routine. For the smaller tubes the standard adult-sized oesophagoscope or speculum was used, but for larger tubes the Instrument oesophagoscope is necessary. The latter instrument was to be the one of choice if it could be easily passed. After maximal dilatation of the stricture a tube of corresponding size was pushed into position on a guide bougie with the aid of a home-made ring introducer, in the usual manner.

CASE REPORTS

Case 1

A 30-year-old male was admitted on 15 October 1958, 2 months after intentional swallowing of caustic soda. He was able to swallow only fluids with difficulty. A barium swallow revealed a long mid-oesophageal stricture. Oesophagoscopy showed the upper end of a mature circumferential stricture at the level of 24 centimetres, admitting a no. 6 bougie. The stricture was dilated with difficulty to no. 18 but there was no bleeding. An equivalent sized FPT was inserted through the stricture and left *in situ*. Thereafter swallowing was effortless for fluids and a light diet, and the patient was not aware of the foreign body in the oesophagus. During the following 3 months repeated dilatations and insertions of FPTs were carried out, the longest period of permanent canalization being 2 weeks, with no reaction, and the original maximal lumen was maintained. At this stage the patient, who is emotionally unstable, became very difficult and, after a few bouts of heavy alcoholism, insisted on leaving. It was decided to replace a FPT and to allow him to go home. He was discharged on 2 January 1959, 3½ months after admission. He returned as instructed one month later complaining that swallowing had become more difficult

Fig. 2. Case 1: (*a*) On admission, (*b*) FPT *in situ*, and (*c*) 9 months later.
Fig. 3. Case 2: (*a*) Stricture, and (*b*) FPT *in situ*.
Fig. 4. Case 4: (*a*) Stricture, and (*b*) FPT *in situ* after 6 weeks.
Fig. 5. Case 5: FPT in position in cervical oesophagus.

during the last week. On oesophagoscopy on 3 February 1959, the tube could not be found and the stricture appeared free from reaction. Dilatation was easy, but with no. 14 slight bleeding occurred and larger bougies were not used. The same happened a week later, and by the following week swallowing had again become difficult—even swallowing fluids.

A barium swallow showed a long mid-oesophageal stricture which closely resembled those seen in the original studies. Again the patient became difficult and demanded the re-insertion of a tube and discharge. After much deliberation a no. 14 FPT was replaced on 25 February 1959, whereupon he again swallowed satisfactorily and he was allowed to go home. He returned on 8 April 1959 swallowing well and looking a different person. On oesophagoscopy the appearance of the stricture was good but no FPT was seen. (This was the third tube he had swallowed, all of which were passed *per rectum* unnoticed.) Amazingly enough, dilatation to no. 18 was now uneventful and, as this dilatation was easily maintained at subsequent sessions, he was taught self-dilatation and discharged. He was last seen in September 1959, when he was still swallowing well (Figs. 2*a*, *b* and *c*).

Case 2

A 2-year-old child was admitted in 1955, 2 months after she had accidentially swallowed caustic soda. There was a mature circumferential stricture 3 cm. below the crico-pharyngeus. During repeated attempts to find a lumen the oesophagus was perforated. After recovery a gastrostomy was performed and she was sent home to return when 4 years old for reconstructive surgery.

She returned on 26 February 1958, when a lumen was found with urethral filiforms and the stricture dilated to no. 5. After repeated dilatations during the next 8 months a dilatation up to no. 17 was achieved. This could, however, not be maintained for more than 2 weeks, when she repeatedly reverted to a no. 7. There was a gradual deterioration and on 15 January 1959 the stricture could only be dilated to a no. 12. A size 12 FPT was inserted and left *in situ* for 1 month when it was removed. No signs of irritation were seen. A week later a size 14 FPT was inserted and she was again discharged for 1 month. This was removed on 25 March 1959 and again no reaction was seen. Unfortunately at this stage she developed chicken pox and was not seen for a month. However, on 22 April 1959 dilatation up to a no. 14 was easily achieved without bleeding, but during May and June the stricture again deteriorated until in July it could only be dilated to no. 9. This was a distressing result after so much promise and it was decided that she should undergo reconstructive surgery as originally planned (Figs. 3*a* and *b*).

Case 3

A 6-year-old child was admitted on 19 April 1958, 3 weeks after she had accidentally swallowed caustic soda. She was able to take only fluids with difficulty. A mature fibrous circumferential stricture was found at the level of 22 centimetres admitting a no. 7 dilator. The stricture was dilated to no. 20. During the next 6 months repeated dilatations were very unsatisfactory and maximal dilatation actually deteriorated to a no. 13.

On 21 November 1958 a forcible dilatation was made to no. 14 and FPT inserted. She swallowed and tolerated the tube well and was discharged for a month. On 19 Desember 1958 the FPT was removed but there was marked reaction and bleeding at the stricture site. Swallowing, however, remained satisfactory and test dilatations to no. 14 were maintained without effort or bleeding. On 30 January 1959 she was discharged on a full diet, and on 13 February 1959 the stricture appeared healed and was again easily dilated to no. 14. She returned on 4 June, 1959 with the FPT obstructed by a button, but dilation was again effortless. It is felt that further dilatations may not be necessary.

Case 4

An 18-year-old boy was admitted on 24 November 1957, 3 months after a Mes operation was performed for a long corrosive stricture. An S-shaped anastomotic stricture was found and repeated dilatations were instituted without progress over a period of 1 year.

On 20 October 1958 the stricture was dilated to no. 18 and a FPT inserted. In spite of the tube being so near the larynx, it was well tolerated and swallowing was very satisfactory. Two weeks later there was no mucosal reaction and a new FPT was inserted. After a further 2 weeks there was still no reaction and the stricture was dilated to a no. 22 and another FPT inserted. This was left *in situ* for 1 month when a slight reaction was noticed and the stricture was rested for a week. A new FPT was then inserted and the patient was discharged to the country on an almost full diet. He returned a month later after again having noticed slight difficulty in swallowing during the previous week. No tube was found in the stricture which had regressed and would now only dilate up to a no. 16. This regression was quite definite, and was disappointing after 3 months of permanent canalization. It was felt that the marked tortuosity of this S-shaped stricture was perhaps responsible for the failure. The patient was referred for plastic surgery to the anastomotic site. This has been unsuccessful and he now has a stricture which dilated to a no. 12 (Figs. 4*a* and *b*).

After failure of direct surgery to the stricture, this case again presented in a very unsatisfactory condition. Repeated dilatations were attempted, but a no. 12 could not be maintained for more than 2 weeks. Dilatation to no. 14 was then carried out and a FPT was again inserted for 5 weeks. There was no reaction and canalization was uneventful. Since the removal of the FPT the stricture can be dilated readily to no. 15; this has been well maintained for 2 months. A barium swallow showed no hold up, and the patient has been discharged, swallowing well. It is felt that no further dilatations are necessary—a highly satisfactory result in a difficult case.

Case 5

This was an elderly lady of 74 who had had a postcricoid carcinoma successfully treated by the Radiotherapy Department in 1953. However, shortly after the treatment she developed an impermeable cricopharyngeal cicatricial stricture. She had to lead a 'gastrostomy life' since that time as repeated examinations had revealed no recurrence but also no lumen. On 15 February 1959 retrograde dilatation was successful and it was possible to pull a Ryle's tube through the structure. A week later anterograde forced dilatation to no. 7 was done and a FPT inserted. Again, in this case, the flange was only just below the arytenoids but was well tolerated, and she readily took mashed solids and bread by mouth—for the first time in 4 years. After 2 weeks, there having been no reaction, a forced dilatation to no. 18 was done and a new FPT inserted. She was discharged on a full diet. A month later no tube was found, there was still no reaction, and an ambitious dilatation to no. 19 was done with re-insertion of a FPT. Some discomfort now occurred but, as this appeared to settle, she was again discharged. She returned 3 weeks later not swallowing too well and complaining of pain in the neck and of hoarseness. Indirect laryngoscopy showed a left recurrent palsy and, on oesophagoscopy, the flange was seen to have passed into the stricture and the tube could only be moved by pushing it through into the stomach. There was a fairly marked mucosal reaction but no evidence of recurrence of the original growth. Although we confidently expected the recurrent nerve to recover, it was considered inadvisable to continue dilatations and the stricture subsequently regressed to the extent of dysphagia even for liquids. She has reverted to gastrostomy feeding (Fig. 5).

Case 6

A 2-year-old child was admitted with a mature fibrous circumferential stricture 4 cm. below the cricopharyngeus following accidental ingestion of caustic soda. Dilatations performed elsewhere had failed and the child was referred for consideration of reconstructive surgery. Fortnightly dilatations showed no improvement over a period of 3 months and on 11 February 1959 a dilatation from no. 6 to no. 15 was done and a FPT inserted. This was well tolerated and the child was discharged able to swallow well. On 11 March 1959 the tube was removed and a gross reaction with bleeding granulation tissue was found. This was not particularly disturbing in the light of our experience in Case 3, but unfortunately this stricture subsequently regressed, dilating only to a no. 11 in June. Repeated dilatations have again been instituted, and in September a dilatation up to a no. 14 was effected.

Routine Care

All cases with benign strictures canalized with a FPT were put on penicillin and streptomycin systemically for 3 days after insertion, and on hibitane lozenges 2 hourly. In addition, as long as the tube was *in situ*, 100 mg. of ascorbic acid and amphogel were given 3 times daily after meals. Barium swallow, X-ray of the chest, and sedimentation rate investiga-

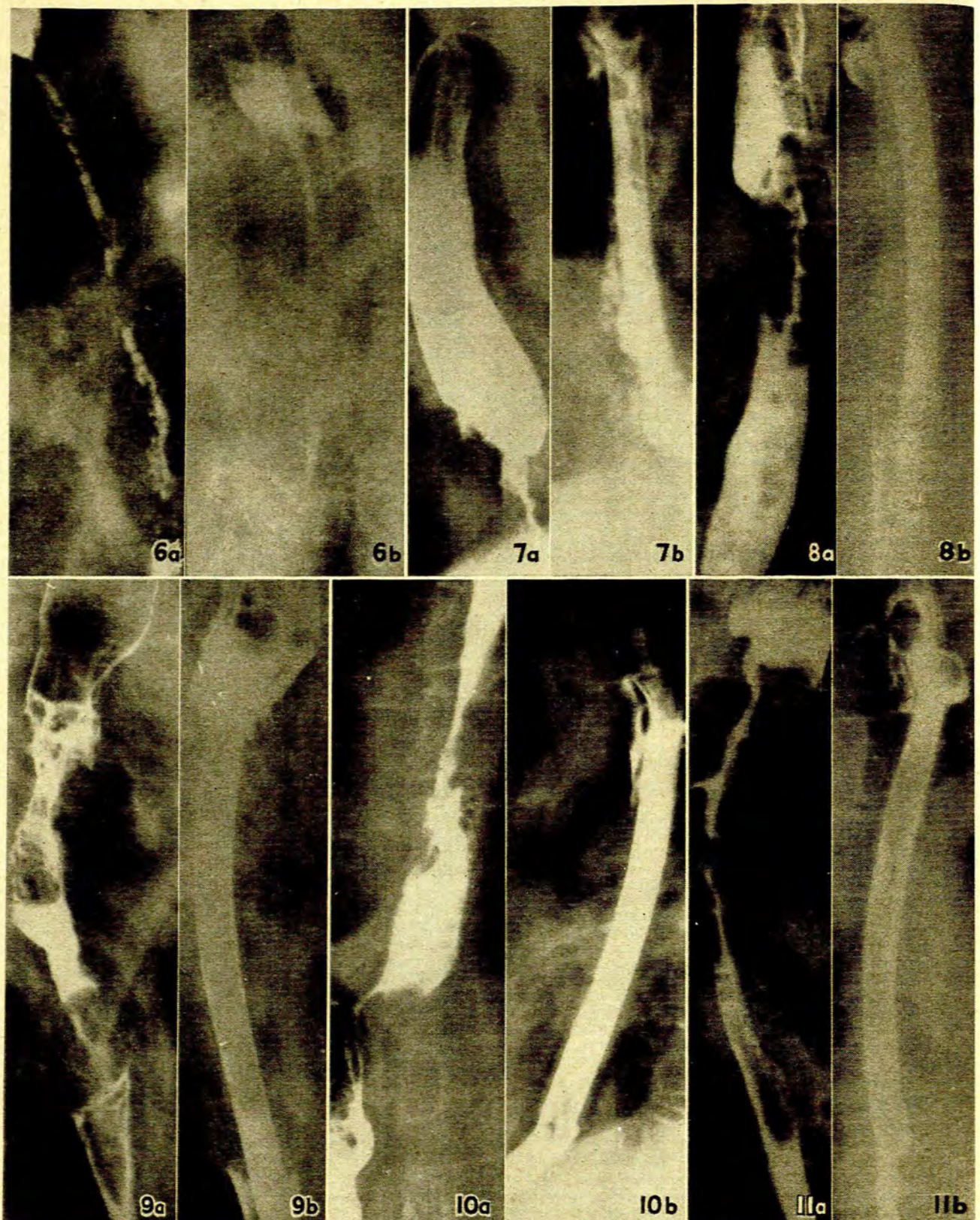


Fig. 6. Case 7: (*a*) The malignant stricture, and (*b*) the FPT *in situ*. *Figs.* 7-11. Each figure shows (*a*) the malignant stricture, and (*b*) the FPT *in situ*.

tions were carried out as a routine in the beginning of the series.

Diet depended entirely on the cooperation and intelligence of the patient, but in hospital all the above cases were on a full puréed diet, with the exception of meat and fish in any form.

Fate of the Tube in the Oesophagus

Patients were generally unaware of tubes in the oesophagus, though Case 5 appeared to know whether a tube had been left *in situ* or not. Even by palpation, in Case 4, after the tube had been *in situ* for 6 weeks, it was not possible to decide clinically whether the tube was still present or not.

All tubes removed after one month had an unpleasant smell and, although the lumen was clean, the flange was invariably covered with adherent debris which was responsible for the odour. After about 2 weeks in the oesophagus, portex changes colour, becoming fairly black and mottled after a month. Proportionately with this colour change portex becomes slightly harder. In the early stages of this investigation a tube was regurgitated into the pharynx by Case 1 and some tubes were passed into the stomach, but on all occasions faulty insertion, or insertion of too small a tube, had been suspected. Slipping of the tubes through the stricture was distinctly unusual and, when this happened, their passage through the alimentary canal was readily traced by X-ray. Case 1 passed 3 tubes unnoticed, one of which was a size 14 and 12 cm. long. The only case in which there was a hold-up of the tubes was in Case 5, an elderly subject who had had a gastrostomy for years. These tubes, only one of which had slipped through on its own, were held up in the stomach for several months and removed at her final gastrostomy. They were black and hard, but no abnormality was present in the stomach.

Only on two occasions were tubes obstructed by food—then only partially, and on each occasion firm long fibrous strands were removed from the flange extending into the lumen. These tubes were both size 14, the smallest that allowed a normal diet in this series, although Case 1 survived a month on a size 12 without obstruction.

Endoscopic removal of the tubes, grasping forceps being used, was at all times simple and uneventful.

CONCLUSIONS

In this series we have only been concerned with mature stricturing. Although no definite staging was attempted, these were all circumferential strictures not maintaining dilatations and greater emphasis was placed on the dilator admitted rather than the dilatation achieved. It would have been interesting to compare these cases with similar cases who, in the past, have had to receive repeated dilatations over a period of years, but unfortunately the series is too small. The need for endoscopy and hospitalization was considerably reduced in the 2 successful cases in this series (Cases 1 and 3), but the unsatisfactory reactions in the other cases regrettably precluded any further studies.

The reason for the big variation in the mucosal reactions is not completely clear, but 3 factors come to mind. (1) Portex is not completely non-irritant, (2) the collection and putrefaction of food debris under the flange, and (3) in order to achieve a maximal serviceable lumen with the initial FPT many of the dilatations were forced above the limits which one would normally have regarded as being reasonable.

Further work is necessary with non-irritant materials, of which many, such as silastic, are now becoming available.

It seems certain that permanent canalization of the strictured oesophagus may be possible, and this might open the field for skin and perhaps vein grafts. There can, however, be no doubt that, at present, portex is entirely suitable for maintaning the tiny lumen for short periods to facilitate the next dilatation and, in the meantime, for maintaining a reasonable food intake. The flanged portex tube described will, in certain cases of stricture, obviate the necessity for gastrostomy, which will also ensure a clear upper abdominal field for reconstruction by a surgeon.

Malignant Strictures

The effects of starvation and thirst on the patient with an inoperable carcinomatous stricture of the oesophagus must have been foremost in the mind of Souttar when he developed his metal tube over 25 years ago. This problem is perhaps particularly important in South Africa where carcinomatous stricture of the oesophagus occurs predominantly among the more primitive races, who cannot understand or manage a gastrostomy.

Souttar's tube has stood the test of time without opposition. The Symonds' tube offered a very poor challenge, and it is in this field in particular that the FPT excels.

The following case is presented to illustrate the advantages to be derived from the use of the FPT.

Case 7

An 86-year-old male was admitted on 10 October 1958 with a history of progressive dysphagia for 9 months followed by sudden complete obstruction. Oesophagoscopy showed a carcinoma with complete obstruction at the level of 25 centimetres. After dilatation to no. 16 a FPT was inserted. On biopsy a poorly differentiated keratinizing squamous carcinoma was diagnosed. Bronchoscopy was normal. Swallowing was entirely satisfactory after the insertion of the FPT and remained so until the patient died of general manifestations in July 1959 (Figs. 6*a* and *b*).

Radiographs only of the other cases are presented (Figs. 7-11).

The advantages of the FPT are summarized in Table I.

TABLE I. ADVANTAGES OF THE FPT

	Souttar	*FPT*
1. Availability	Imported—not always available	Available in any theatre
2. Length and size	Restricted	Any measurement
3. Site	Not any part of oesophagus	Any part
4. Reaction	Mucosal more marked, may not be tolerated	Mucosal less marked, unnoticed by patient
5. Weight	Heavy	Light
6. Maintenance of position	Unstable	Secure
7. Blocking	Occasionally by food, often by growth	Seldom by food, uncommonly by growth
8. Detection in body	Very radiopaque	Radiopacity satisfactory
9. Passage	Not readily passed through alimentary canal	Readily passed through alimentary canal
10. Price	Expensive	Inexpensive.

CONCLUSIONS

Many cases of neoplastic strictures, whose final assessment is not yet available, are discharged after the insertion of FPTs

and presumably remain alive and able to swallow. There appears to be no reason why the FPT should not allow satisfactory swallowing until the patient dies from extension, or other effects, of the growth. Some of the advantages enumerated in Table I are very striking. The most useful of these advantages appears to be the choice of length and size of the tube, the superiority of the flange in maintaining the position of the tube, and its ready availablity in any operating theatre.

In cases of carcinomatous stricture where surgery is contemplated, pre-operative positioning of a FPT may offer a decided advance in improving the patient's general condition pre-operatively—always so urgently necessary, and usually so inadequate by the intravenous route and not entirely satisfactory by gastrostomy or jejunostomy. Further work may also be considered regarding the use of a flanged portex or plastic tube as an applicator for direct radiation of the oesophageal growth.

SUMMARY

1. A simple method of making a flanged portex tube is described.

2. The insertion of this tube into benign and malignant strictures of the oesophagus for purposes of prolonged canalization is described.

3. The results obtained in a series of cases of caustic stricturing and neoplastic disease are discussed from representative case reports.

4. X-ray views of cases are shown before and after canalization.

5. The advantages of a Souttar's metal tube in the treatment of cases of carcinoma of the oesophagus are compared with the apparent advantages of the new flanged portex tube.

I should like to thank Mr. R. J. V. Milner, who originally suggested the idea of a plastic tube to me, and Dr. A. B. Bull, who showed me how portex tubing could be moulded. I should also like to thank Mr. D. J. Roux, Head of the Department of Otorhinolaryngology, for his constant advice and encouragement, Dr. J. I. Levy and members of the Radiology and Radiography staff for their willing cooperation, Mr. B. Todt for the photographs and the technicians of the Plastic Laboratory who made the introducers. Finally, I wish to thank Prof. J. H. Louw for his encouragement and access to his cases, and Dr. J. G. Burger, Superintendent, Groote Schuur Hospital, Observatory, Cape, for permission to publish.