

## Surgical management of acquired subglottic stenosis

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Surgical management includes the initial evaluation, tracheostomy and subsequent monitoring of the child requiring surgical reconstruction, although most of this presentation concerns reconstructive techniques and results. Previous presentations have dealt with the initial endoscopic and radiological evaluation of children who present with stridor due to acquired subglottic stenosis: this includes microlaryngoscopy and bronchoscopy in order to determine the anatomical and functional situation in the larynx and tracheobronchial tree. Mr. Bull has discussed the techniques involved and Dr. Facer the anaesthetic aspects.

### Endoscopy

At Great Ormond Street these children are serially endoscoped at intervals dependent upon the severity of the stenosis, usually between 3 and 6 months. The subglottis is sized by judging the fit of different sizes of Storz bronchoscope. Initially we used the endotracheal tube sizing technique, but found it less reliable than the bronchoscope, partly because of difficulties in angulation when the tube is passed and also because it is more difficult to judge accurately the fit of a tube.

If the airway seems to be growing satisfactorily, some children can be decannulated without the need for surgical reconstruction. If the airway is not enlarging satisfactorily surgical reconstruction is indicated. My 'rule of thumb' is that if the child is one bronchoscope size down from normal, the airway is probably adequate for decannulation, but if the child is two sizes down it is not. I delay surgical reconstruction until the age of about 2 years or a minimum weight of 10 kg. Some surgeons operate a little earlier, at the age of 12-18 months, but others will not contemplate laryngotracheal reconstruction until very much older, say age 9, 10 or 11. One needs to consider the severity of the stenosis, as the child with a pinhole opening will clearly not grow to achieve an adequate airway however long you wait. For the child with a marginal airway which may well improve with time it is worth waiting longer, and possibly considering endoscopic treatment using the CO<sub>2</sub> laser (Simpson *et al.*, 1982).

### Surgical reconstruction

There are two types of surgical reconstruction. The laryngotracheoplasty (LTP) employs the classical cas-

tellated incision described by Evans and Todd in 1974, and is used almost exclusively for congenital subglottic stenosis where the cricoid cartilage is grossly thickened. The cartilage ring structure can be reasonably clearly defined, and the castellated incision made through it. In acquired subglottic stenosis there is chondritis or perichondritis, extensive fibrosis, loss of the normal architecture and no clearly defined ring structure to castellate. An LTP is therefore technically not possible and a laryngotracheal reconstruction technique (LTR) is used with a vertical split. This is essentially an augmentation technique using a free costal cartilage graft anteriorly and/or posteriorly (Cotton, 1978).

During the period 1975-1985, 131 reconstructions were performed at Great Ormond Street, 40 per cent of which were laryngotracheoplasties for congenital stenosis. In the second half of this period, most of the children had acquired stenosis and required an LTR procedure with an anterior graft in 37 per cent anterior and posterior in 18 per cent and posterior only in 5 per cent. Those children requiring a posterior graft only were in a special category, with primarily posterior pathology and dense interarytenoid scarring.

### Operative technique

The horizontal skin incision for the procedure is centred just above the cricoid, which enables me to reach as far as the hyoid above and the tracheostome below (Fig. 1). I next perform a laryngofissure starting from above and splitting vertically down in the mid-line. It is essential to divide the anterior commissure precisely in the mid-line, although it can be quite difficult to identify under direct vision when there is marked subglottic scarring; otherwise, subsequent anterior blunting will substantially impair voice quality. In acquired stenosis the split is continued vertically through the stenotic segment (Fig. 2) which is then stented open.

I routinely stent laryngotracheoplasties and both anterior and posterior rib grafts using the silastic 'swiss roll' described by John Evans in 1974 (Fig. 3). The Aboulker Teflon stent, an alternative favoured by some surgeons, is a solid moulded stent which is fitted integrally as part of the tracheostomy (Aboulker *et al.*, 1966); however, it is wired to the tracheostomy tube which cannot therefore be changed should the need arise. Furthermore, it shares with other rigid stents (such as the Montgomery silastic laryngeal stent) the

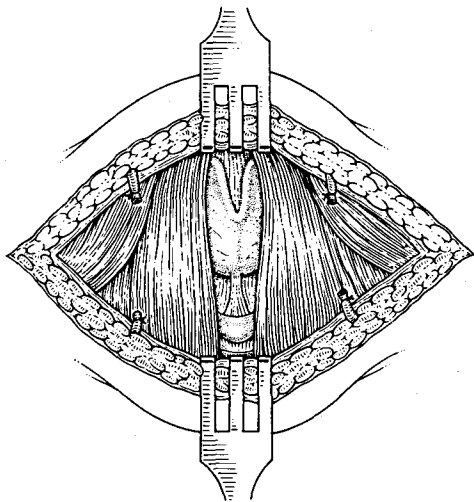


FIG. 1

The strap muscles are separated to expose the larynx and upper trachea.

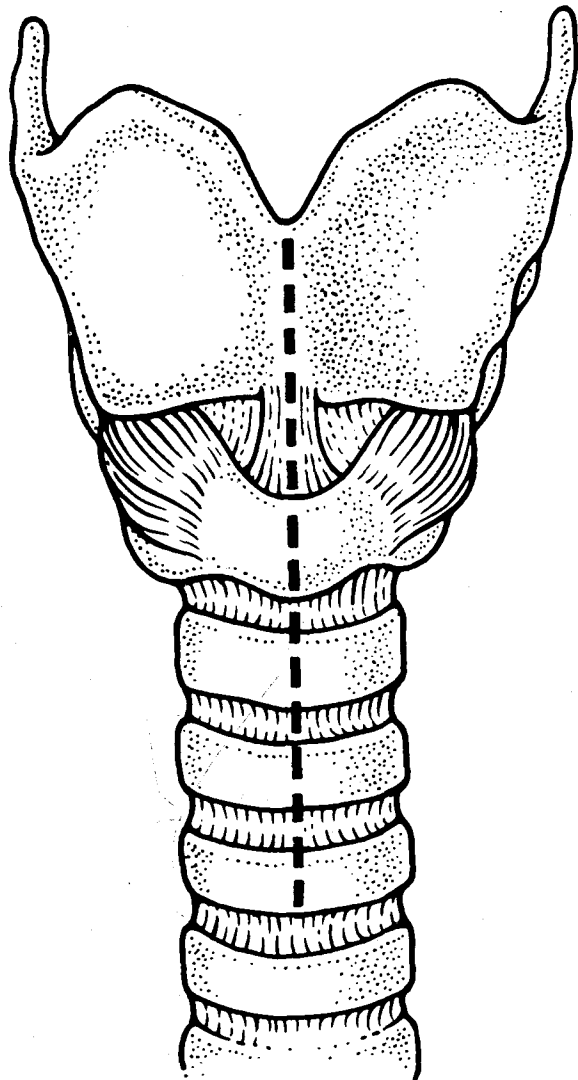


FIG. 2

A laryngofissure is extended down through the stenosis.

disadvantage of only being available in a limited number of sizes, whereas the Evans 'swiss roll' is individually tailored to each patient, and is self-adjusting when in place. One needs to be careful not to allow the silastic to ride up too high during the closure. If it does, aspiration tends to occur because the rolled part of the stent pushes up through the cords and the glottis becomes incompetent. Care should also be taken to prevent rotation of the stent whilst the prolene transfixion stitch is inserted (Fig. 4), otherwise the glottis becomes incompetent because the 'wings' at the top of the silastic roll do not lie in the correct antero-posterior plane between the vocal cords. In either event, the stent can be trimmed endoscopically.

With the stent in position, the costal cartilage graft can be slotted into place as a boat-shaped piece of cartilage and secured with sutures of 5-0 Vicryl (Fig. 5). It is crucial that the top of the graft does not extend up into the laryngofissure split because, if it does, the pointed top tends to open the laryngofissure and blunting or squaring-off of the anterior commissure results. I have perichondrium on the medial surface only to provide a lining. There is a theoretical risk in doing this that the cartilage graft will curl if it is cut too thin; Evans tends to use it with perichondrium on both sides for this reason, although this makes the graft rather bulky.

When the wound is closed, the transfixion stitch securing the silastic stent is tied through a polythene catheter across the strap muscles, and a nylon twist drain is inserted (Fig. 6).

In the case of a pinhole airway, or total subglottic obliteration (Fig. 7), it is necessary to put in a posterior as well as an anterior graft in order to obtain adequate augmentation of the lumen. This procedure is exactly as for an anterior graft, but having made the laryngofissure and split down the front of the stenotic segment, the cricoid is then incised posteriorly as described by Rethi (1956). Cotton *et al.* (1981) describes obtaining one millimetre of distraction posteriorly for each year of life,

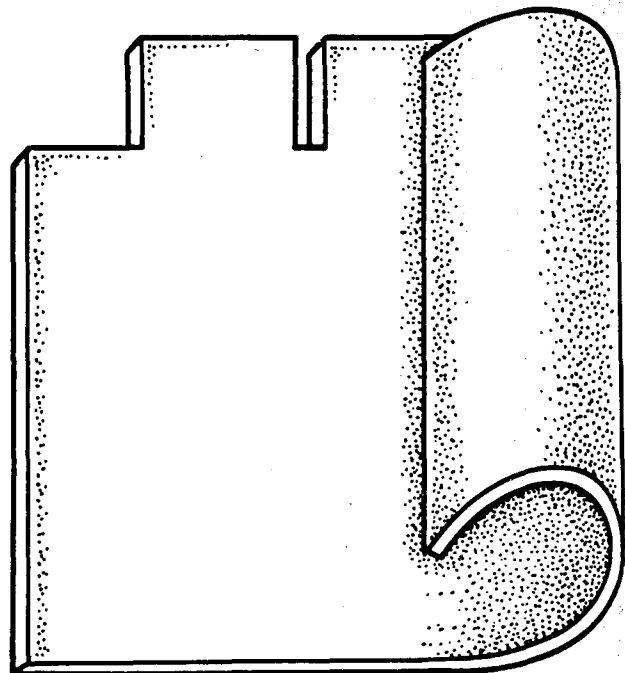


FIG. 3

Silastic sheeting is cut to form the 'swiss roll' stent.

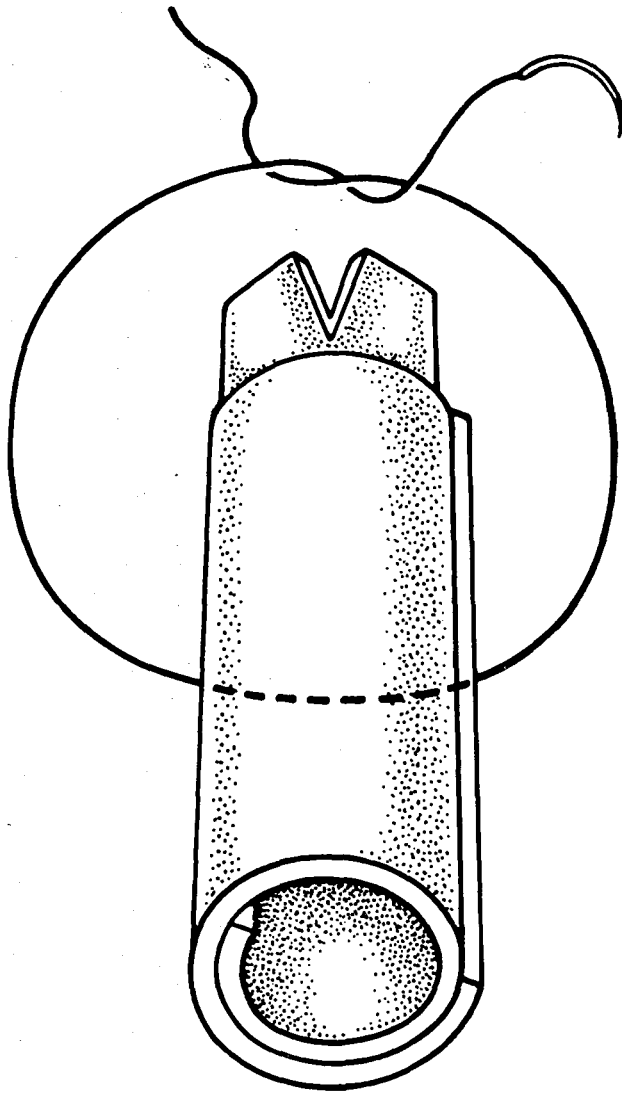


Fig. 4

The stent is secured with a transfixion stitch which passes through the trachea.

but I find you can achieve more than that. The posterior costal cartilage graft is secured with sutures of 6-0 Vicryl (Fig. 8).

#### Post-operative management

For a laryngotracheoplasty with the castellated incision, the stent is usually left in for 6 weeks; with an anterior graft usually about 8 weeks; with an anterior and posterior graft a minimum of 3 months; and for children who tend to re-stenose and in whom one undertakes revision surgery, as long as 6 months. Evans has some particularly refractory cases in whom the stent has been left for even longer. The stent is then removed endoscopically, using a small incision in the original scar to divide and remove the transfixion suture. It is advisable to re-scope the child 7-10 days later to remove any granulation tissue and so to avoid possible re-stenosis.

#### Decannulation

Some suprastomal prolapse of the anterior tracheal wall as described by Bull is fairly inevitable, but is not

usually a problem with decannulation. The average time interval from removal of the stent to decannulation varies a little between the various forms of reconstruction in our series:

- 7 months for laryngotracheoplasty
- 9 months for anterior rib graft
- 6 months for anterior and posterior rib graft
- 7 months for posterior rib graft

These figures do not only reflect the state of the airway, but also the fact that it is not always possible to admit children immediately for decannulation, as we now have a decannulation waiting list. Ninety-two per cent of the laryngotracheoplasties have been decannulated and 60 per cent of the laryngotracheal reconstructions. However, the LTP's were predominantly in the first 5 years of the study and most of the reconstructions in the second half, since 1980; thus a number of the reconstructions still have the stent in place or else it has only just been removed. Elimination of these patients not yet ready for decannulation shows that just over 80 per cent of our LTR's have been successfully decannulated.

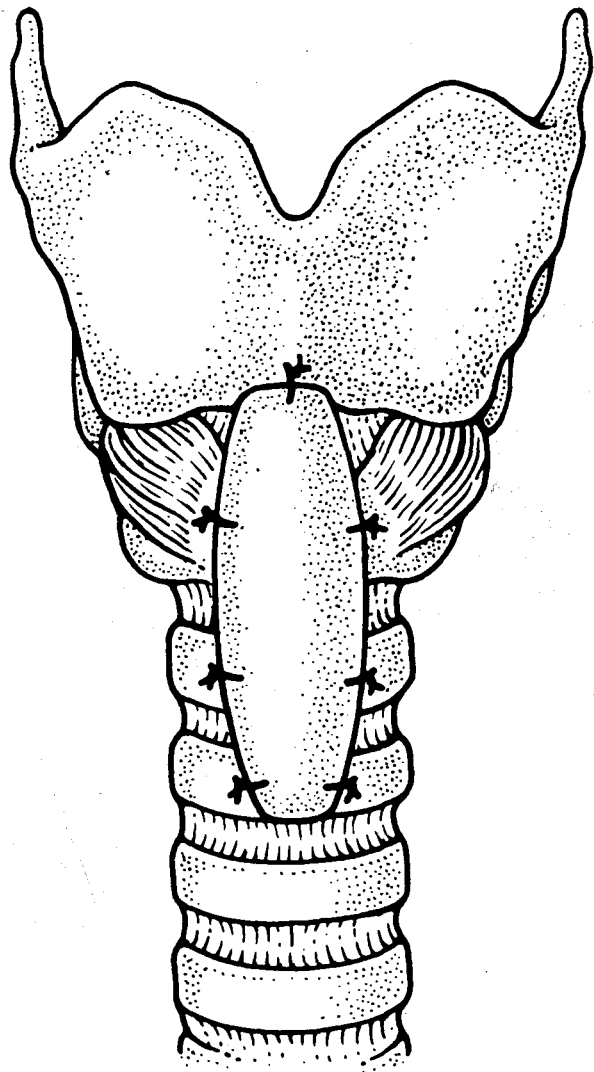


Fig. 5

The costal cartilage graft is sutured into place using 5-0 Vicryl.

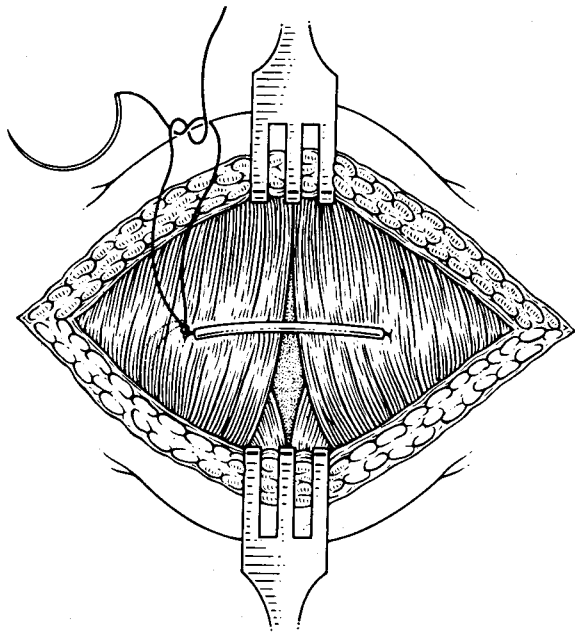


FIG. 6

The transfixion stitch is tied through a polythene catheter across the strap muscles.

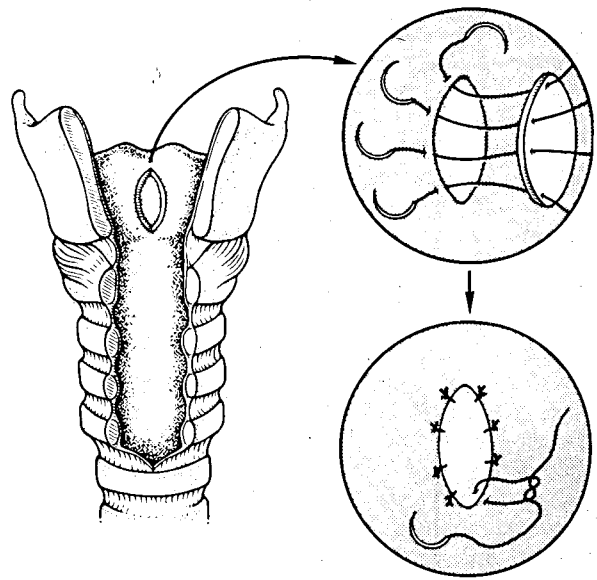


FIG. 8

The technique for inserting a costal cartilage graft into the posterior lamina of the cricoid.



FIG. 7

Lateral neck X-ray showing subglottic obliteration secondary to intubation.

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