

## Urethral stricture

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THE earliest records of medicine are much concerned with the management of urethral strictures by means of catheters and sounds. In ancient India Susruta described the use of a reed catheter lubricated with ghee\*. In Greece, Socrates was known to joke about the gleet of others, and poor Epicurus committed suicide when he could no longer dilate his own stricture. In Rome in the first century, Celsus described the operation of external urethrotomy for a calculus impacted behind a stricture, and urethrotomy became part of the canon of classical medicine preserved by the Arabs only to be re-discovered in the Renaissance, when Ambroise Paré (1510-1590) devised an instrument for scraping 'carnosities' from the urethra. Silver catheters armed with a concealed lancet were in use in 1795, and in 1817 Civiale of Paris devised a practical internal urethrotome, improved by Maisonneuve in 1848 to screw on to a filiform guide. Gonorrhoea to the ancients was hardly more than a cold in an awkward place: Boswell makes little of his own attacks, and the gleet put a gentleman in the company of the great, which included Henry IV and Napoleon (Attwater, 1943; Lytton, 1976; N. I. Lopatkin, personal communication, 1977).

For many years the distinction between gonorrhoea and syphilis was obscured by their common origin:

'Gonorrhoea has some relation not understood to syphilis: it is capable of producing inflammation of the joints and of the mucous membrane and internal structure of the eye, and is the common cause of stricture' (Mayo, 1836).

To the practical surgeon, there were several recognizable varieties of stricture:

'There are three kinds of stricture of the urethra; the permanent, the spasmodic, and the inflammatory. The permanent stricture is the result of a thickening of the urethra from chronic

inflammation . . . Spasmodic stricture arises either from a contraction of the muscles surrounding the urethra, or from the urethra itself . . . Inflammatory stricture . . . is generally produced by the inflammation of gonorrhoea; but there is another mode by which it is caused, and that is, the introduction of a bougie . . .'  
(Castle, 1831).

The treatment of stricture was essentially by means of intermittent bouginage:

'Bougies are made of either wax, catgut, or silver: and they are usually numbered from 1 to 16 according to their dimension, so that the surgeon may, on each occasion, know the size he is using, and the size last used' (Castle, 1831).

The word bougie is of some interest: *Bujyah* was the name of the Algerian town from which came the best wax for candles, for, as Castle again writes:

'The wax bougie is the one in general use . . . with respect to wax bougies, before introducing them into the urethra, you should always warm them by the fire, for the purpose of rendering them soft; when, if they are introduced into the urethra, and pass through the stricture, you will ascertain the distance at which it is situated from the orifice and the form and size of the stricture will be modelled on the bougie'  
(Castle, 1831).

Not all strictures would yield to the wax bougie, and indeed Castle himself preferred one made of silver—having first explored and obtained a cast of the stricture with a warmed wax one. An instrument virtually identical to the silver bougie was in regular use for the diagnosis of stone in the bladder—the silver sound clicking against the hard calculus—and over the years in the treatment of stricture the word *sound* became synonymous with *bougie* so that today they are interchangeable (Lytton, 1976; Attwater, 1943; Loughnane, 1948).

\* Rendered butter used for cooking.

When modern pathology was introduced in the wake of the application of the microscope to human tissues surgeons began to realize that any cause of inflammation would lead to granulation tissue formation, and that this would be followed by scarring, which would give rise to contracture in the skin, and stricture in a hollow organ such as the urethra. Unfortunately there seemed no way to hinder the process, and surgeons were obliged to rely on regular dilatation as the standard method of management of a stricture. Indeed, even today, regular gentle and skilful dilatation is still the standard against which any other method must be measured (Blandy, 1976a).

It is small wonder that generations of surgeons cast about for some more effective method. Of these the use of 'escharotics', i.e. caustic soda or silver nitrate fused to the end of a silver bougie, were in common use in the eighteenth and nineteenth centuries, but with variable success, and with no great permanence (Castle, 1831). Again and again surgeons devised new kinds of knife with which to slit the stricture from within:

'Puncturation or division from within, I have employed successfully, and recommend it in impervious stricture situated in the first four inches of the urethra—that is to say, in the part which admits of being drawn into a straight line. At the common situation of stricture this method is dangerous and uncertain' (Mayo, 1836).

Despite the newer instruments of Maisonneuve and Otis, the position had not changed a century later:

'Internal urethrotomy is an operation of choice, not of necessity, and by itself does not cure. It must be followed by full sized bougies at regular intervals until eventually twice a year for the remainder of the patient's life' (Loughnane, 1948).

Sometimes urethrotomy caused severe haemorrhage—an accident which led Fenwick to abandon the Otis instrument at St Peter's (Attwater, 1943).

Forcible rapid dilatation was also tried again and again—every urological department has a drawerful of rusting Kollmann's dilators, now quite out of favour:

'The evolution of expanding dilators was from those surgeons who favoured rapidity, and who contended that they could quickly cure a stricture. However, events showed that strictures rapidly dilated were prone to recur, unless bougies were subsequently passed at regular intervals, and if this were not done then the ultimate condition was much worse, because of increased fibrosis' (Loughnane, 1948).

The fundamental difficulty was to prevent contracture in the scar around the urethra, and it was from the experience of the plastic surgeon dealing with burns that the urologist learned that only the application of skin could inhibit the contracture of connective tissue. The severe aftermath of deep burns posed an analogous problem to the plastic surgeon: if he had the opportunity early in the course of the burn, he would remove the dead tissue, apply split skin and prevent contracture. If he only came in late in the course of the disease, he had to make use of Y-V and Z-plasties with which to insert a gusset of supple and healthy skin permanently to enlarge the contracted scar. To do this in the urethra was plainly very difficult. Probably Duplay (1886) was the first to devise such an operation in which at the first stage the stricture was slit open and sutured to the edges of the penile or scrotal skin. When it had healed and the scar was mature, at a second stage Duplay fashioned a new urethra from full-thickness skin. Duplay's operation was probably never very successful (Immergut, 1967) for it was often succeeded by fistulae and infection. In those days without fine catgut or antibiotics, and with only irritating red rubber catheters, primary healing in the perineal skin could have occurred only in the exceptional case.

At the same period, others were experimenting with the use of large full thickness skin patches for the repair of large hernial defects, only to find that after a few months the skin would fold up into a pouch or tube, hairy side on the inside. This tendency for a tube to be formed from a buried skin strip led Denis Browne (1936) to devise an operation for hypospadias which was so successful that surgeons came to his theatre to learn how to do it, amongst them Johanson (1953) and Swinney (1954) who adapted Browne's principle to the problem of the complicated or impassable urethral stricture of the adult (Fig. 1). At the first stage the narrow inflamed part of the urethra was laid open or cut away entirely. When it had healed, a skin strip was used to form a new urethra (Fig. 2).

Such an operation was however not without its difficulties, for fistulae were common, and unless great care were taken with the measurement of the skin strip, the new lumen was either too big, or too small. Kaufman, Pearman and Goodwin (1962) reported their own disillusion and their results—no fewer than 5 of their first 10 cases developing a new stricture after the first stage of Johanson's operation. In London the foremost exponent of Johanson's procedure was undoubtedly Turner-Warwick, whose teaching at St Paul's Hospital, influenced his contemporaries (including the writer) who had never until then witnessed such a radical attempt to cure a stricture (Turner-Warwick, 1960). They were

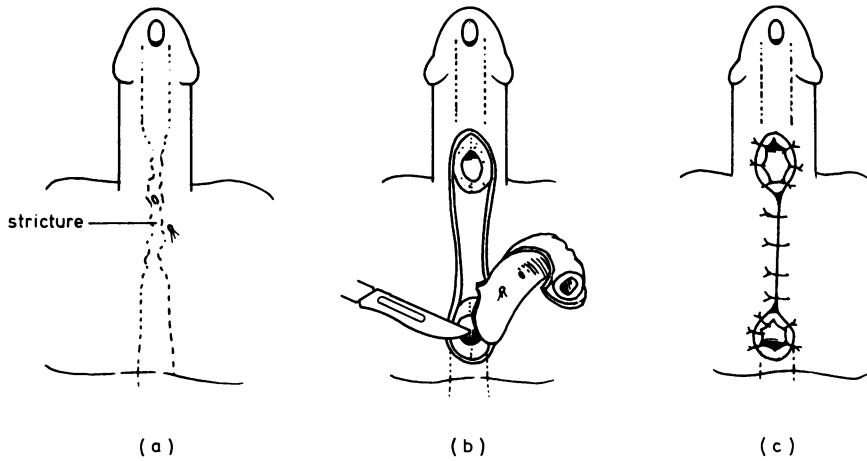


FIG. 1. The buried skin-strip urethroplasty of Swinney Denis Browne and Johanson: the narrow and diseased urethra is cut out (a, b), leaving a gap between the 2 ends (c).

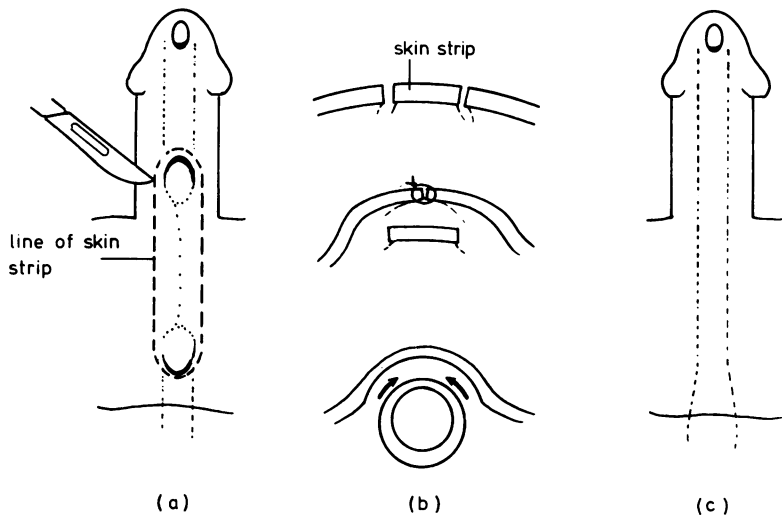


FIG. 2. At the second stage a new urethra is formed by outlining a strip of skin between the 2 ends (a) which is then buried (b) and as it regenerates forms a new skin tube (c).

impressed with the excellence of the results, and the flexibility lent to Johanson's method by the use of the skin of the scrotum in Turner-Warwick's own modification. Having the good fortune to return to the London Hospital in 1964, where a large number of patients were still attending the stricture clinic, the writer had the opportunity to gain experience of many otherwise intractable cases, an experience which was augmented on his appointment to St Peter's Hospital 5 years later. No two surgeons do the same operation in the same way, and in this writer's hands a different design of scrotal flap was

used, similar to that evolved independently, and for the same reasons, by Williams and Crawford (1968) in Sheffield, Leadbetter (1960) in Boston, and de Klerk in Capetown (1974) (and no doubt by many others—who found it easier to place the stitches before tying them, and the  $\cap$ -shaped scrotal flap easier to work with). What any of these techniques had in common was the chance it gave the surgeon to see at first hand the lesion which for generations had been felt only blindly with the tip of the bougie and the sound. In the clear daylight, strictures proved to vary considerably in their macroscopic

appearance and histological detail. At the same time, the need to explore the urethra from end to end in order to enlarge it demanded that surgeons take a new interest in what had for so long been of little concern to him except as the gateway to the bladder.

The new freedom and indication to explore the urethra coincided with the availability of a revolutionary new endoscopic optical system devised by Professor Harold Hopkins – another unsung British genius of the calibre of Barnes Wallis and Frank Whittle – who had already invented the zoom lens (pirated by the Japanese) and the flexible fibre glass light and endoscopy systems. The Hopkins rod-lens system, developed by Karl Storz, provided a brilliantly clear view of the inside of the urethra. Again, electronic measuring devices allowed von Garrelts (1956, 1972) to analyse the physical characteristics of normal and disordered micturition. Armed with this new technology, surgeons began to think again about the anatomy and physiology of the urethra, both in the male and the female.

#### Anatomy of the urethra

Far from being a simple pipe for conveying urine from the bladder to the exterior, the urethra has a most complex structure. At rest the lumen is folded and crumpled, like an empty sock. In ejaculation

and micturition its contour changes according to the volume, viscosity and force with which its contents are expelled. In micturition its contour as seen in the voiding cysto-urethrogram (Fig. 3) reveals 2 narrowings one at the external sphincter, the other at the junction of bulb and pendulous urethra. In the breech it is wider than the barrel, and the muzzle is choked like a shotgun.

The interior of the urethra is mainly smooth, but pitted with innumerable openings of mucus-secreting glands whose purpose is still obscure. In the bulb, the wider urethra is rifled by helical bands raised up by sub-mucosal strands of muscle (Moorman, 1975) which give this part of the urethra a characteristic appearance on endoscopy. The openings of the para-urethral glands are more prominent in this part of the urethra and the glands themselves larger and more complex. The 2 largest glands, those of Cowper, are provided with long ducts which readily fill on urethrography to give rise to the erroneous diagnosis of a false passage (Fig. 4).

Surrounding the mucosal tube of the urethra is a thick sleeve of erectile tissue, the corpus spongiosum, whose sinuses communicate with those of the glans penis, but are under separate physiological control from the twin corpora cavernosa (in priapism the corpus spongiosum and glans penis remain flaccid,



FIG. 3. Normal urethrogram: there is a normal narrowing at the level of the external sphincter (a) and at the junction of the bulbar and membranous urethra (b).

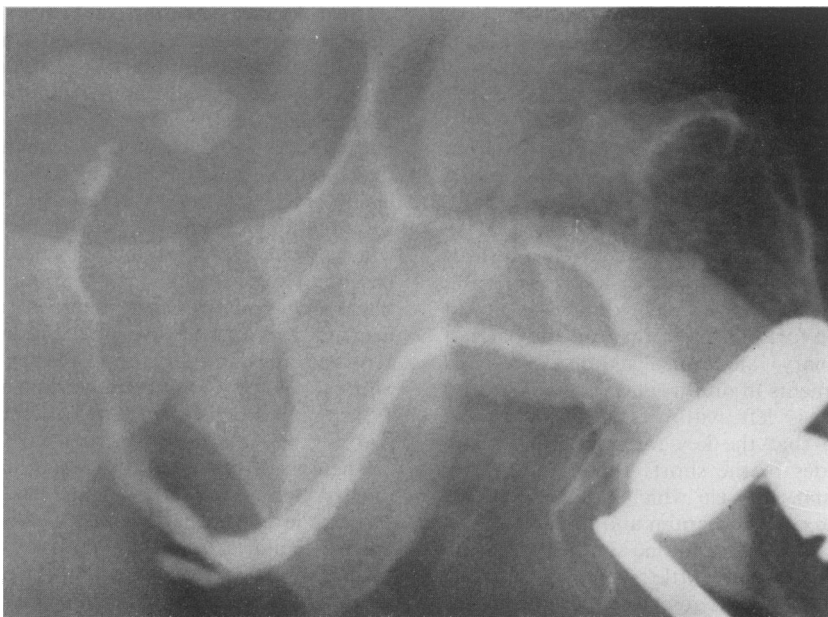


FIG. 4. Urethrogram showing a long stricture, the dilated duct of Cowper's gland clearly showing below the bulbar urethra.

the erection being limited to the corpora cavernosa). In each corpus cavernosum, wide venous sinuses are separated by thin-walled bulkheads of connective tissue the flow of blood into and out of them being controlled by arteriovenous anastomoses, small cushions rising and falling in their walls to divert blood now in and now out of the sinuses. The para-urethral glands ramify in the substance of the corpus spongiosum, making it easy for pus to break out from their acini into the vascular spaces to give rise to an inflammatory phlegmon or, worse, to septicaemia.

Muscle fibres both smooth and striated can be found running longitudinally and around the urethra and presumably have some role in altering its shape in voiding or on ejaculation. Few studies have been reported as to their role, but H. Marberger (personal communication, 1977) has noted that the urodynamics of the flaccid urethra are those of a smooth walled shotgun, whereas in erection the stream is more narrow and the flow projectile – as would be expected from a rifle.

Surrounding the bulb, and continuing up and over each corpus cavernosum, are the obliquely running fibres of the bulbospongiosus muscle, which is striated and under voluntary control. It can be readily verified that this muscle is capable of compressing the urethra to help to squeeze out residual urine or semen, but its main purpose may be more subtle. It may be the mechanism which, as has been

measured in the Shetland pony stallion, boosts the pressure 10 times higher than its carotid arterial pressure during ejaculation although, in the paraplegic, with flaccid bulbospongiosa, erection may still proceed without interruption (Blandy, 1976a).

In relation to the operations which are to be performed on the urethra, of crucial importance are the systems which preserve urinary continence. In the male these seem to have 3 interrelated parts. Immediately upstream of the bulbar urethra the channel is surrounded by the external sphincter annular striated muscle fibres belonging to the levator ani shelf, and sandwiched between the fasciae of the pelvic floor. As with other striated mammalian muscles, the external striated muscular ring is not designed for sustained contraction, but added to it, probably partially enclosed within it as a separate collar, lies a second ring of involuntary alpha-adrenergic muscle (Droes, 1974) which, Blacklock (1976) concludes, may be the mechanism which preserves continence after division of the third component, the bladder neck; or after urethroplasties, in which the striated muscular ring of the external sphincter is divided. In view of the physiological concept of muscular sphincters with triple innervation, cholinergic, adrenergic and somatic, and in the light of physiological observations which are being reported with increasing frequency both in animals and in man, surgeons must now learn to regard the all too simple notions of an external and

an internal sphincter with mistrust. At the same time in planning any urethral reconstruction, it is necessary to be exceedingly wary, lest some important nerve pathway, or some vital muscular ring, is inadvertently injured.

It does seem safe enough to cut the external sphincter, so long as the bladder neck and the supramembranous involuntary muscle is intact: and it may be possible to remove the bladder neck, so long as the rest of the system is undamaged (Edwards *et al.*, 1972; Colapinto and McCallum, 1976). But these happy results have been obtained almost entirely by good fortune rather than on the basis of sound preliminary anatomical knowledge, and future improvements in urethroplasty may not be so successful. One is left with the suspicion—at the time of writing—that the key to long-term urinary continence resides in the short cuff of tissue containing involuntary muscle which lies between the lower end of the verumontanum and the upper edge of the external sphincter, and one shudders to think how often this precious little piece of anatomy comes within range of the resectoscope loop or the urethroplasty needle. In the presence of benign nodular enlargement of the prostate, which will be seen in the majority of elderly patients with a stricture, the continence mechanisms are even further in peril, as they are pushed laterally and downwards.

Alongside the new interest in the functional anatomy of the male urethra has been intensive study into the structure and physiology of the female. Even simple concepts of its normal length and width have been reviewed. Uehling (1978) made careful measurements with bougies à boule of 250 women requiring surgery for carcinoma of the cervix without urinary symptoms. He concluded that there was a considerable normal variation, the mean calibre being 22 Ch  $\pm$  s.d. 2.9 Ch (circumference in mm), i.e. a diameter of 7 mm  $\pm$  1. One may compare this with the dogma of an earlier generation (Winsbury-White, 1948) 'the normal adult female urethra should admit without gripping

an instrument of a calibre of 24 Ch'. In view of the widespread practice all over the world of forcibly dilating women's urethrae it is as well to be reminded that they come—as do other anatomical features—in different sizes.

If width is to be variable, one might also suppose that urethrae might show a normal variation in length. Lapides (1961) formerly believed that there was a critical length of female urethra less than which would lead to incontinence, a conclusion based on experiments in which the excised dog's bladder was progressively deprived of its attached urethra, and on the use of a graduated catheter. His findings are not supported by Roberts and Smith (1976) who found a normal range of from 1.5 cm to > 5 cm in their series of urethrae measured with a graduated Foley catheter.

There is also considerable variation in the type of mucosa lining the normal female urethra. The lower end of the urethra is embryologically derived from the urogenital sinus in common with the vestibule of the vagina whilst its upper part is derived from the lower parts of the Wolffian ducts, and is lined with transitional epithelium. There is a junction (Fig. 5) between transitional and squamous epithelium which can lie on the trigone in some 8% of patients, just below the internal meatus in 24%, and about half way down the urethra in the remaining 78% (Roberts and Smith, 1976). Since this lower part of the urethra is a target, along with the vulva, for oestrogen stimulation, it shares in the generalized post-menopausal changes which are seen in the vagina. This is also the explanation for the common endoscopic finding of 'leucoplakia' on the trigone: biopsy of this whitish film shows it to be vaginal metaplasia which can be regarded as of no pathological consequence.

Even the place at which the female urethra normally opens is subject to a degree of normal variation in relation to the inferior border of the pubic arch, a variation which has (inevitably) been thought to be a cause of dysuria and frequency when no other cause can be found for them.

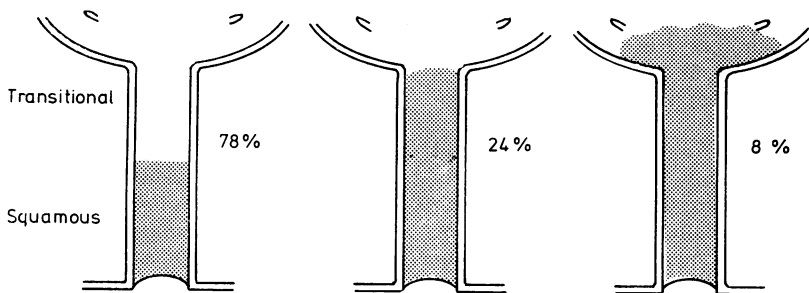


FIG. 5. The variation in the junction between urethral squamous epithelium and urethelium (after Roberts and Smith, 1976).

Entering the urethral mucosa are the openings of innumerable para-urethral glands which extend out into the sinuses of the erectile tissue which surrounds the urethral tube. Reconstructions of serial sections of the female urethra show the complexity and richness of these glands, but their function remains an enigma.

More knowledge has been obtained about the muscular structure of the urethra since this is of obvious relevance to the common and distressing symptom of urinary incontinence which haunts every gynaecological and urological clinic. Just as in the male urethra, what was once thought of as a simple tube guarded by an internal and an external sphincter, one voluntary, the other involuntary, so in the female the physiology of the musculature of the urethra proves to be far more interesting and far more complex.

A ring of levator ani muscle can be identified between the layers of pelvic fascia, just as in the male, but within this ring is enclosed a second cone of involuntary muscle fibres some of which are in continuity with fibres from the detrusor of the bladder. It is these involuntary fibres which are giving rise to most interest today. They are supplied by both  $\alpha$ - and  $\beta$ -adrenergic nerve elements, which are interrelated to a surprising extent by a series of reflexes. Each interdependent system can be altered pharmacologically: each varies from one experimental animal to the next, and in man, each would seem to be a suitable target for some pathological process (Gosling and Dixon, 1975; Awad and Downie, 1976; Khanna, 1976; Caine, 1977).

The female urethra proves to be not only a complicated neuromuscular organ, but it is one which is subjected to huge distortions, as in childbirth, and in the physical changes which occur with the hormonal tides of menstruation, and the atrophy of the menopause. The correct timing of the relaxation of the voluntary external sphincter can be seriously altered by psychosomatic disturbance, and may cause gross outflow obstruction from consciously maintained bad habits, or unconscious disturbances (Allen and Bright, 1978; Johnston, Koff and Glassberg, 1978). Generations of surgeons have grown accustomed to the idea that the female urethra needs to be forcibly stretched from time to time: today we must ask ourselves just what we think we are doing, and whether the observed changes are not merely variations in the wide spectrum of normality.

### The aetiology of stricture

#### *Congenital strictures—in males*

By the time the infant is born, he has been micturating *in utero* for many months, and a boy who is born with an outflow obstruction may at birth have all

the upper tract dilatation and hydronephrosis, and all the chronic retention and sacculation in the bladder which one might expect of his grandfather with a neglected prostate. In such boys there is a thin strong membrane shaped like a spinnaker, at

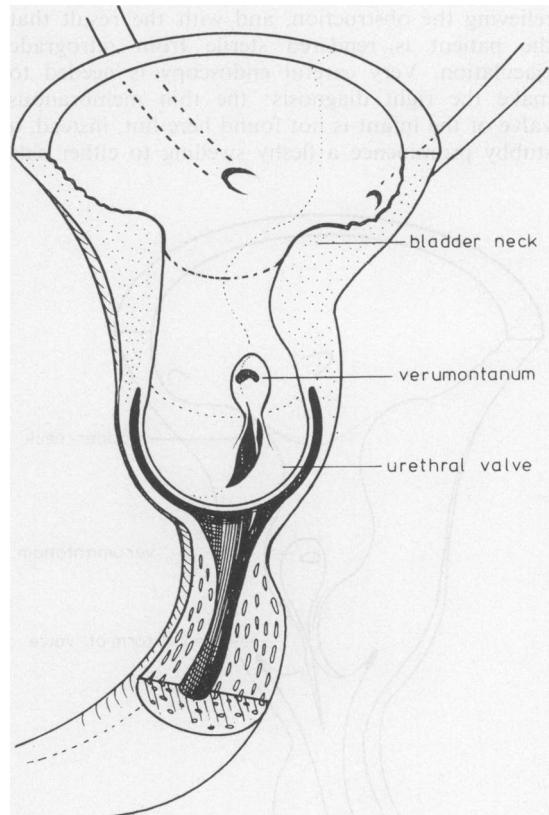


FIG. 6. Congenital posterior urethral valve.

the lower end of the prostatic urethra (Fig. 6). Like a spinnaker, it is perforated by a more or less narrow slit through which the urine flows with difficulty in a poor trickle. In severe cases the child is born with a grossly distended bladder and palpable ureters, sometimes even with a leak of urine into the peritoneal cavity (Johnston, 1976). When the hole in the spinnaker is larger, the condition may be unnoticed at birth, but a little boy will be brought to the doctor because he 'dirties when he wets'. The diagnosis is made with a cystogram. The thin membrane is easily severed with a miniature resectoscope, but the upper tract damage may be so severe as never fully to recover (Johnston, 1976).

Congenital posterior urethral valves are usually detected in childhood, but there is a small number

of adults in whom the valve is less narrow, and in whom the diagnosis is only made because of the discovery of chronic retention, uraemia, or infection. Now, the hypertrophy of the detrusor is accompanied by thickening of the bladder neck which, unless we are on our guard, is readily accepted as the cause of the obstruction, and resected, without relieving the obstruction, and with the result that the patient is rendered sterile from retrograde ejaculation. Very careful endoscopy is needed to make the right diagnosis: the thin membranous valve of the infant is not found here but, instead, a stubby prominence—a fleshy swelling to either side

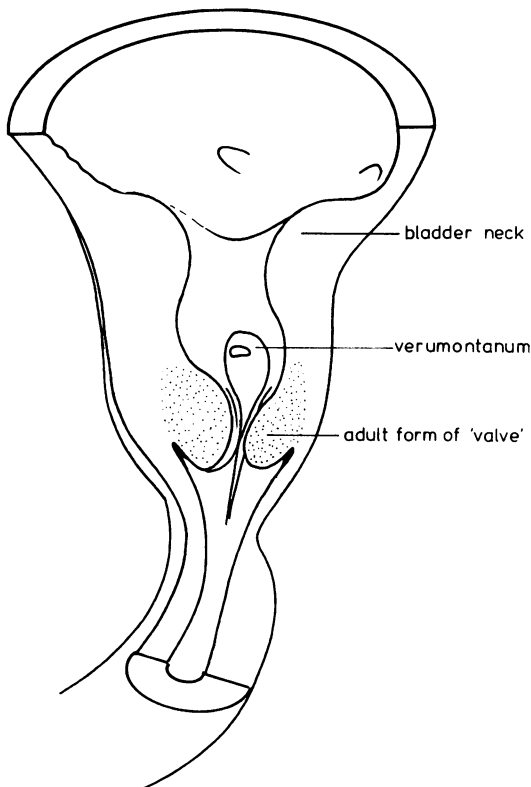


FIG. 7. Adult form of the congenital posterior urethral valve.

and in front of the verumontanum (Fig. 7). The differential diagnosis must include voluntary (or subconscious) failure to relax the external sphincter, and this may need electromyographic studies during micturition. Urethrograms are puzzling in these cases, perhaps because they are too rare to be recognized easily. Their treatment is easy—the little stubs of tissue are carefully resected, but one must take extra care not to carry the loop of the resectoscope so

deeply as to threaten the ring of involuntary muscle on which continence depends (Drouin, Laperrière and Grégoire, 1978; Szemat-Nikolajenko and Cukier, 1978).

Less well recognized are congenital obstructions in the mid-bulbar urethra (Fig. 8). These are rarely detected in childhood although Johnston (1976) and Gibbons, Koontz and Smith (1979) cite perfect examples. Many urologists are sceptical as to their existence: when the writer presented his own first 17 cases in 1975 to his paediatric surgical colleagues they were unconvinced. The stricture is exactly where one finds strictures after trauma or surgery. Nevertheless the pattern of the clinical picture is constant. Symptoms of urinary infection bring the adolescent to the doctor and, on investigation, the first surgeon to pass an instrument notices a stricture in the mid-bulb. It is always in the same place, and it is always thin, as if someone had ligated the bulb with a thread. When dilated it may yield easily, and not recur, but as a rule it returns within a very short time. Sometimes these strictures do well with routine dilatation, and others are cured by urethrotomy, but the need for urethroplasty in the remainder has given the author the chance to obtain a biopsy of the tissue making up the stricture and it is composed not of the expected scar tissue, but of hypertrophied muscle (Singh and Scott, 1975). For this reason, the author believes that it represents an exaggeration of the normal muscular rifling described by Moorman (1975). Of course, other things may give rise to stricture in this situation: it may follow in the wake of childhood urethritis (Williams and Mikhael, 1971), possibly the effect of repeated external trauma from bicycle riding, or internal abrasion from the unadmitted insertion of a foreign body into the urethra. Proof, in the absence of histological evidence, must remain wanting. Unfortunately, in the 31 cases answering this description in the writer's series, such proof has been available in only a tiny proportion. The congenital origin of these strictures is however accepted by Szemat-Nikolajenko and Cukier (1978), Golimbu *et al.* (1978), and Gibbons *et al.* (1979).

A third congenital stricture is found in the anterior part of the urethra. This is beyond question of congenital origin, and it fits into the spectrum of those congenital errors in which there is an attempt by the ingrowing genital folds to form a double channel for the penile urethra (Fig. 9). These are often called 'anterior urethral valves' but really they are double-barrelled urethrae, the extra barrel being slung under the normal one, and opening into it through one or more holes in the septum which separates them. The additional channel is surrounded by cavernous tissue and forms a ballooned-out version of the corpus spongiosum.



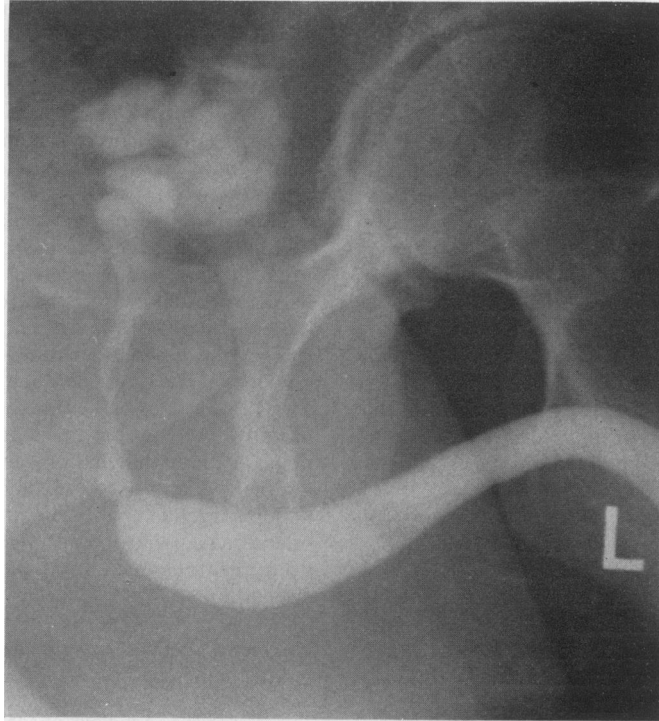


FIG. 8. Congenital annular stricture in the mid-bulbar urethra.

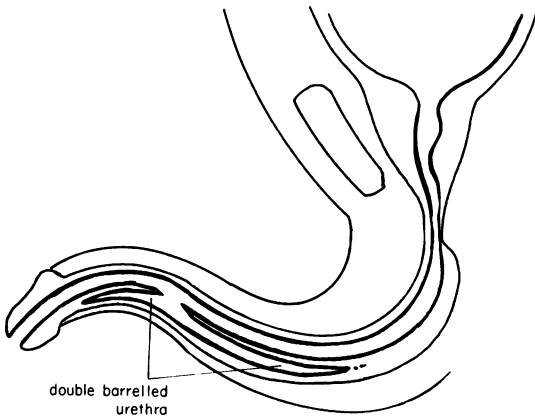


Fig. 9. Congenital 'anterior valves' of the urethra: in reality these are variations on the theme of the double-barrelled urethra.

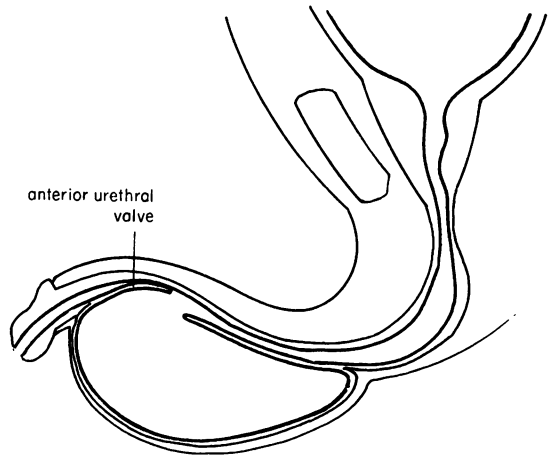


Fig. 10. As the child voids, the double barrel fills and squeezes the normal urethral channel.

Urine fills out the extra urethra, which swells until the septum is forced against the lumen of the main urethral channel and closes it (Fig. 10). The child having emptied his bladder into the distended extra urethra then slowly empties it, and so he is

always wet, and is brought along to the surgeon (as a rule) because of continual incontinence. Once or twice these boys are admitted with an abscess formed by infection in the distended diverticulum and when the purulent urine is let out by incision of the

'abscess' a permanent fistula is formed. The diagnosis is usually obvious once one watches the child trying to pass water, and the remedy is to remove the extra barrel of urethra and close the hole by a one- or 2-stage urethroplasty. The condition is well recognized now: Williams and Retik (1969) published 17 cases, Firlit, Firlit and King (1978) 13 cases, and Cendron and Desgrez (1975) 14 cases. Moskowitz, Newton and Lebowitz (1976) have added 5 very similar cases which they attribute, probably incorrectly, to retention cysts of Cowper's gland. The age at which these patients come to hospital varies considerably: the oldest of the writer's cases was a railwayman of 57 years who had been aware of a hard lump in his perineum for several years, and who was found to have a calculus the size of a hen's egg in a typical ventral diverticulum. It had only given trouble when the stone rubbed against the cross-bar of his new cycle.

True meatal stenosis of the external opening of the glans may be seen in association with hypospadias (Johnston, 1976). So also may there be a genuine congenital narrowing of the opening of the prepuce, but most of the children brought to hospital with a preputial or meatal stenosis have an acquired stricture there, caused by ammoniacal dermatitis. It is for this reason that whenever possible, circumcision is deferred until the child is continent and out of napkins. Scarring of the prepuce in the uncircumcized child is easily remedied by removing the foreskin, but a tight meatus will require meatotomy, and even then, the stenosis may recur, and a meatoplasty be needed. This is not the place to enter into a detailed discussion of the indications for circumcision, which the writer has dealt with elsewhere (Blandy, 1977).

As for the minor forms of narrowing of the external meatus which some urologists have alleged to be common, Litvak, Morris and McRoberts (1976) carried out careful measurements of the meatal calibre in boys aged from 6 weeks to 3 years, and came to the astonishing conclusion that 15% of boys suffered from significant meatal stenosis, requiring the attention of a surgeon. It is conceivable that in the population studied by these workers there were an unusually large number circumcized in infancy and suffering from meatal scarring as a result, but it is more likely that their measurements represent the expected statistics of variation about a norm.

#### *Congenital urethral strictures in females*

These fall into 2 categories—real and imaginary. Of the real stenoses, one is associated with the 'covered meatus' described by Johnston (1976) in which a crescentic fold of vaginal skin covers an external urinary meatus from behind. Other even more rare

anomalies may be found to cause obstruction to the urethra, e.g. the para-urethral cysts observed in a newborn girl by Blaiavas, Pais and Retik (1976).

Given far more attention in the literature, especially from North America, are the imaginary stenoses of the urethra. There is a deep rooted conviction that urinary infection must be caused by urinary obstruction, and when a meticulous investigation of a child with recurrent urinary infection fails to reveal any mechanical cause for it in the upper tract, then the urologist is apt to discover something wrong with the bladder neck or the urethra. Among the proponents of the existence of a true collagenous ring at the external meatus were Lyon and Smith (1963), whose views received widespread credence. The subject is discussed in the context of treatment more fully below. At this stage the writer wishes to make it plain that in his view the condition is yet another example of those mass delusions which afflict surgeons from generation unto generation: one recalls nephroptosis, redundant colon, clitoridectomy, tongue tie, and the evergreen grumbling appendix.

#### *Traumatic strictures of the urethra—in males*

Iatrogenic trauma heads the list (Table 1) and

TABLE 1. Aetiology of 445 urethral strictures

|              | No. | %    |
|--------------|-----|------|
| Congenital   | 31  | 6.9  |
| Traumatic    |     |      |
| Accidental   | 101 | 22.7 |
| Iatrogenic   | 156 | 35.1 |
| Inflammatory |     |      |
| Gonorrhoea   | 87  | 19.6 |
| Tuberculosis | 7   | 1.6  |
| Unknown      | 63  | 14.1 |
| Total        | 445 | 100  |

here the largest proportion follows the use of an endoscope or a catheter. Inadvertent laceration of the urethra with the endoscope is very common: the writer has probably made this mistake more often than most, for it occurs even in experienced and gentle hands when the urethra is inflamed or crooked. It seldom if ever leads to stricture, nor does stenosis follow the clean incision of the inside of the urethra with a sharp knife. Indeed, routine internal urethrotomy actually diminishes the incidence of postoperative stricture after transurethral resection (Emmett *et al.*, 1963; Chilton *et al.*, 1978; Blandy, 1978; Bailey and Shearer, 1978). Urethroscopy a few weeks after such an internal urethrotomy shows a cleanly-healed white hairline scar without narrowing.

On the other hand, when a catheter lies for too long in the urethra, one can see broad white patches—unmistakable bedsores—where the catheter has

pressed against the urethral mucosa. They occur where the urethra is most narrow, i.e. at the external sphincter, the peno-scrotal junction, and just inside the external meatus (Fig. 11). The importance of only using narrow catheters cannot be overstressed, and it is still strange to see how often a large (e.g. 24 Ch) catheter has been left in a man's urethra merely to deal with urinary retention, when a 12 Ch or 14 Ch sized tube would have conducted the urine away just as easily.

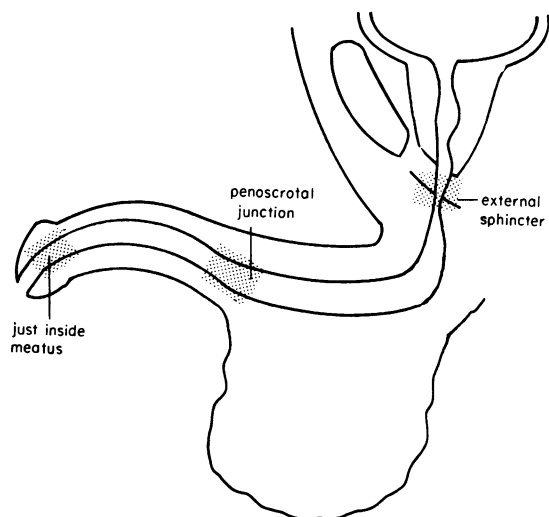


FIG. 11. The usual sites for iatrogenic strictures caused by an urethral instrument or catheter.

The need to try to use small instruments applies particularly to transurethral resection, where remarkable differences in the reported incidence of post-resection stricture may reflect variations from one centre to another in the calibre of the resectoscope in use. Otherwise it is difficult to explain the 8.9% of stricture reported by Lentz *et al.* (1977) compared with the 1.9% found in the writer's cases by Chilton *et al.* (1978).

Another cause of stricture arising from damage to the lumen of the urethra has been the passage of a urethral calculus, or perhaps the instrumental manoeuvre needed to remove it. These cases are not common in the United Kingdom, but are frequently seen in hot climates (Amin, 1973).

Endoscopic diathermy for small tumours in the urethra will be followed by coagulative necrosis and scarring: in bygone days, when antiseptics were often injected into the urethra as part of the treatment of urethritis, it is probable that chemical inflammation was a contributory factor to the high incidence of stricture, today so rarely seen after

gonorrhoea. Among these chemicals, we should include formaldehyde: for until quite recently formalin cabinets were the routine means of 'sterilizing' catheters and bougies for the urological department. In these cabinets dry formaldehyde vapour sublimed on to the outer surfaces of the instruments in a thin coating of paraformaldehyde—totally useless as an antibacterial agent, but when allowed to come into contact with the lining of the urethra, exceedingly irritating. The writer can recall the severe purulent urethritis which used to follow in days when the old gum-elastic catheters, taken from the formalin cabinet, and washed only perfunctorily, were tied into the urethra. This cause of stricture was largely abolished with the introduction of less irritating latex catheters, pre-sterilized by gamma radiation or ethylene oxide gas, but even with the newer compounds, one should be aware of the risk of chemical damage to the urethra arising from the organo-tin compounds added to some plastics, and the sharp particles sometimes used as fillers (Gow 1976). From time to time one encounters a patient who develops a violent urethritis around a latex catheter, and it is likely that in some of these patients there is a true allergy to an anti-oxidant present in the latex rubber.

In women, the writer has seen only one example of this form of stricture, in a patient whose urethra had been treated with silver nitrate as one of the (then) fashionable methods for the management of the urethral syndrome. An intense urethrotigonitis was followed by narrowing of the urethra requiring dilatation. Of course other examples in which the urethra is injured in the course of treatment of gynaecological disorders are well described but, curiously, seldom do they cause a stricture which must be treated. Radiotherapy is one such cause, and in the female urethra, as in the treatment of cancer of the penis, post-radiation fibrosis may lead to a more or less severe narrowing of the lumen of the urethra requiring dilatation or, in rare cases, urethroplasty.

In Africa, female circumcision is still practised. The details of the operation vary from one area to another (Dewhurst and Michelson, 1964; Remondino, 1891; Ghalioungui, 1963). Some tribes remove as much of the labia and the clitoris as they can; some excise the labia minora more or less completely; others content themselves with partial removal of the labia minora which are then sewn together—usually with thorns. Sometimes the post-operative infection and scarring involves the urethra in childhood, but it is more serious when post-circumcision cicatrix leads to obstructed labour.

Post-partum injury to the urethra forms an important element in the loss of tissue which results from pressure necrosis between the fetal head and the

symphysis when there is pelvic disproportion, or the scarred perineum, when there is post-circumcision stenosis. Whatever its aetiology (and there are, all too often, multiple factors involved), the resulting lesion consists of a gross defect in the trigone and the upper part or the whole of the urethra. The lower ends of the ureters are often involved in the loss of tissue, so that when the young woman finally recovers and reaches medical care, the ureters emerge into a kind of cloaca formed by the remains of the bladder and the upper part of the vagina. Part of the picture is severe scarring of the cervix, with haematocolpos.

#### *Strictures caused by external trauma—in males*

From time to time the urethra is involved in some local injury to the penis. The writer's own series has included one young husband whose penis was cut off by his mad wife, and another who put a steel ring on his penis and could not get it off, and only reported the matter when the organ was gangrenous. One patient had used a vacuum cleaner to assist him in masturbating. Occasionally one sees patients with a stricture caused by external radiotherapy for cancer, and the writer has twice seen (elderly) men who had the glans amputated in the Far East as a rather radical treatment for gonorrhoea in their youth. Each results in an individual problem whose treatment cannot be generalized.

The common causes of urethral injury are direct violence to the bulb from a blow on the perineum and injury to the membranous part from fractured pelvis.

Injury to the bulbar urethra was known in antiquity as a disease of sailors. Hapless Jack tars would fall from the rigging astride a spar. Later it became an injury of boys trying to walk along a fence, of undergraduates climbing into college, and in the textbooks of the writer's youth, the city gent who would step on an unsecured manhole and fall astride its iron edge. Today one sees the injury in motor accidents, and sport, particularly skiing, when the skis go either side of a small tree stump.

In all these situations the urethra is forced hard against the inferior edge of the pubis which may be fractured by the violence of the blow. There is inevitably much soft tissue damage to the perineal muscle and fat, and the bulbar urethra is crushed and torn, usually incompletely.

The main danger of this injury is that the patient will pass urine through the damaged bulbar urethra, and inject it into the lacerated soft tissues of the scrotum. The extravasated urine is limited laterally by the attachment of the fascia of Colles and Scarpa to the crease of the groin, and posteriorly where it is bound down just in front of the anal canal, but there is nothing to stop the urine from

seeping up in the fat of the lower abdominal wall. If the urine is hypertonic it will be chemically irritating, and if it is infected, it will give rise to infective gangrene. The neglect of this extravasation leads to loss of the soft tissues and skin over the penis, testicles, anterior half of the perineum and, to a variable extent, the lower part of the abdominal wall. In former days it was usually fatal: today it is still not an uncommon sight in African hospitals, where it calls for prolonged and patient plastic surgical reconstruction. The crucial factor is to let out the extravasated urine so that it cannot injure the skin (Weems and Hillis, 1977). If there is any suspicion of perineal extravasation, it should be drained freely, but opinions differ as to the need for an attempt to repair the laceration in the wall of the urethra. This is invariably untidy, and does not lend itself to a nice suture, while to disturb the lacerated corpus spongiosum may provoke more bleeding. Stricture is not prevented by these attempts at repair, and the writer's own practice is to leave the urethra alone, making sure only that urine is diverted by a suprapubic cystostomy. Then, a few days later, when all the local bruising has subsided, one can inspect the urethra with an endoscope, dilate a stricture if there is one (and there often is not) and, at worst, find a short tight stenosis in the midbulb which readily lends itself to a one-stage urethroplasty. It has been suggested that one should take the opportunity to perform the first part of a 2-stage urethroplasty, i.e. explore these injuries, and sew the edge of the lacerated urethra to the skin. This is unnecessarily meddlesome. The author's limited experience is borne out by others: Waterhouse and Gross (1969) found that 6 of their 9 cases did well with only a suprapubic diversion: Pontes and Pierce (1978) had 16 such cases, of which 15 healed without a stricture, provided suprapubic diversion was performed. In penetrating and gun-shot wounds which call for debridement anyway, Salvatierra *et al.* (1969) recommended an attempt at primary repair, based on their unique experience in Vietnam.

#### *Injury to the membranous urethra in fractured pelvis—in males*

The weakest part of the urethra is its membranous part, where it passes through the muscular floor of the pelvis, and is encircled by the involuntary 'supramembranous' sphincter as well as the more substantial striated muscle of the levator ani sheet. Above, the urethra is part of the prostate, which is firmly bound to the symphysis pubis: below, the bulbar urethra is tethered to the twin corpora cavernosa which are, in turn, fixed to the ischial rami on each side. Fractures of the pelvis fall into several categories (Holdsworth, 1963) and the majority are rather similar to the stress fractures of

the elderly osteoporotic patients who develop fractures of the neck of the femur. They do not involve the whole pelvic ring and they never cause genito-urinary trauma. The urethra is injured only when the pelvic ring is broken in such a way that the proximal fragment can carry with it the prostate, while the distal fragment retains the bulbar urethra. In most instances the prostate is torn off backwards

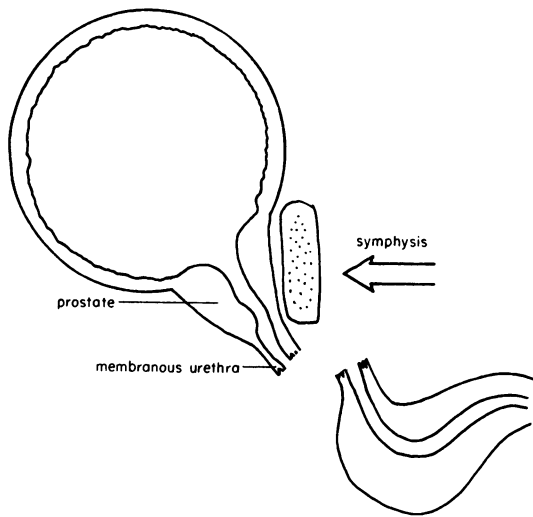


FIG. 12. Backwards and upwards displacement of one part of the fractured pelvis tears the membranous urethra across: the prostate is stuck to the upper fragment, the urethra to the lower.

and upwards (Fig. 12) either because there is an H-shaped fracture, involving pubic and ischial rami on either side of the symphysis, or because the symphysis is ruptured, and the entire innominate bone with pubis and ischium is rotated upwards, shearing at the sacro-iliac joint. The resulting displacement of the soft tissues reflects the displacement of the bony fragments and, unfortunately, when these fractures are severe, it is rare for perfect reduction of the bony fragments to be obtainable. Orthopaedic surgeons argue that perfect reduction of the fractured pelvis is less important than an early return to full function. So long as the pelvis is stable, it is better to return the patient to a normal life, rather than attempt to obtain a perfect radiograph at the expense of months in hospital, bedsores, internal fixation, stiff limbs and deep venous thrombosis. Many young men are therefore left with marked distortion of the bony pelvis, and a long gap may be inevitable between the severed ends of the prostatic and bulbar urethrae.

Today there is a warm controversy as to the correct management of these injuries in the early

stages, a controversy which in the writer's opinion is often beside the point. There are those, on one side of the argument, who feel that when a urethral rupture is suspected, nobody should attempt to pass a urethral catheter for fear it may make an incomplete laceration complete, and a simple fracture compound. Many of these injuries are thought to be incomplete, and to heal of their own accord if left alone. If necessary, it is said, a supra-pubic cystostomy should be done if, after 24 hr or so, the patient has not passed water. If a stricture develops, then the remedy is urethroplasty. This is thought to confer less risk of impotence than any attempt to sew the urethral ends together (Mitchell 1963, 1975; Morehouse, Belitsky and Mackinnon, 1972; Coffield and Weems, 1977; McIlroy, 1976).

On the contrary, many other surgeons believe that bony deformity will necessitate a gap in the membranous urethra, but they feel that every effort should be exerted to make this gap as short and as well aligned as possible: these surgeons, among them the writer, are also unconvinced that the gentle and educated passage of a soft catheter does harm and may, on the contrary, avoid the need for any subsequent operation—even supra-pubic cystostomy (Jackson and Williams, 1974; Malek, O'Dea and Kelalis, 1977; Glass *et al.*, 1978).

Examination of the records at the London Hospital of cases admitted with a diagnosis of fracture of the pelvis revealed 333 consecutive cases, of whom 176 were male, most of whom had no significant urological symptoms. Concerned whether passage of a catheter could be said to have done harm, the author and his colleagues found records of 34 men with blood at the external meatus, or haematuria. A soft rubber catheter was easily passed in 15 of these—only one came back 6 years later with a stricture perhaps related to the catheter; one had a stricture at the time of catheterization, and in a third the precaution was taken to pass a bougie in the out-patient clinic on several occasions during the next few months, but no stricture was ever found. In 10 men, a catheter would not go in easily; 2 were so ill that only a supra-pubic cystostomy could have been contemplated—both developed a stricture. In 8, the rupture was explored and the torn ends approximated over a splinting catheter as soon as the patients were fit for such an operation; 6 had no stricture, or attended merely for annual bouginage; 2 required urethroplasty for a severe stenosis. Probably all 8 would have come to urethroplasty if they had not been operated upon promptly.

As for the veto against the catheter, in this series there were 25 men with massive associated injuries calling for intensive efforts at resuscitation, and a soft catheter was inserted in the intensive care unit to monitor urinary output: 9 of them died of their

other injuries, and 2 needed dialysis for renal tubular necrosis, but none of the survivors developed a stricture. In addition, there were another 16 men, usually elderly, confined to bed with their fractures, who developed retention of urine: all were catheterized, and none has a stricture.

There were also 5 men with blood at the meatus or haematuria on whom no catheter was passed: one died of multiple injuries before he could be resuscitated: in 2, the haematuria was microscopic, and overlooked at the time of admission. One patient had a stone in a solitary kidney, which was removed later. One was found to have a lacerated foreskin.

In fact, on reviewing this material the author and his colleagues were struck with how seldom the choice was offered to the urological surgeon to explore or not to explore: multiple trauma is the rule, and in 11 of the 176 men with fractured pelvis, laparotomy was indicated for signs of internal haemorrhage, and on 4 occasions a laceration of bladder and urethra were found—one died of his associated head injury, but the others were repaired and splinted, and either recovered without a stricture or have to come up annually for a calibrating bougie (Glass *et al.*, 1978).

In this study, the question was also looked at from the other end of the telescope: all the male patients referred to the writer at the London Hospital or St Peter's hospital, with a stricture attributable to external trauma were reviewed, with particular reference to what was done after the initial injury. Of 62 males, only 41 had enough information in their case records or could remember clearly what had been done to them so many years before.

The results are grouped according to 'good' and 'bad' results: this simply distinguishes those in whom there is either no detectable stricture at all, or one which is so short that only a thin membrane separates the bulbar urethra from the prostatic urethra, allowing it to be divided under endoscopic control or, at worst, making subsequent urethroplasty very easy. In those with a 'bad' result there is gross bony displacement, a long uncorrected gap, and often additional factors such as wire sutures, calculi, resistant infection, sinuses, osteomyelitis and fistulae, making the task of effecting a good repair of the long gap particularly difficult. In looking at this material information was found on 25 patients who ended up with a 'good' result and, of these, 22 had undergone an attempt at an early repair after the fractured pelvis (88%). In contrast, in the 19 men with a 'bad' result, cystostomy alone had been performed in 7 cases (37%). The truth cannot be so simply expressed in figures, for when only a supra-pubic cystostomy had been attempted,

it was in most cases not from choice, but because the patient was too ill to allow any more elaborate operation.

When there is a gross deformity of the bony pelvis, it is necessary to remember that the reason why the prostate is kept up and away from the torn bulbar urethra is because it is attached to the free upper fragment of pelvis. To reduce the gap the prostate and lower part of the bladder have to be mobilized, and this is obviously unwise when there is a huge pelvic haematoma, and when multiple tears in large pelvic veins have only just become sealed off with clot. Equally, if attempts are made to bring the prostate down to the bulbar urethra by traction on a Foley balloon in the bladder (one of the traditional techniques advised in older textbooks), the surgeon is essentially attempting the impossible task of reducing the displaced fracture of the pelvis by traction on the soft tissues of the neck of the bladder: not only is this futile, unless the bladder and prostate have been adequately mobilized, but it is certain to lead to a pressure sore at the trigone, and hence possibly to destroy the bladder neck component of the sphincter system.

When the general condition of the patient allows it, then it is the writer's belief that an attempt should be made to reduce the gap, and to get the lumen of the urethra in alignment. Not only may it avoid a significant stricture, as shown in 6 of the 8 cases (75%), but if there is one, it presents an easy problem for subsequent treatment. Malek *et al.* (1977) reported 7 boys aged 6 to 15 in whom early exploration, mobilization, and approximation of the torn ends without tension was performed. In 5, the avulsion was complete; only 4 require dilatation, none need urethroplasty and all are both continent and potent. Janknegt (1975) and Jackson and Williams (1974) report similar results, as also does Kishev (1964) using a different operative approach.

#### *Combined injuries of urethra and rectum* *In males*

In contrast to this advice to attempt, whenever possible, to effect early repair of the ruptured urethra complicating a fractured pelvis, the writer would urge the most extreme caution when the rectum is also involved. Such injuries are mercifully rare, but when they occur, there is massive crushing trauma, multiple comminution of the pelvic ring, laceration not only of the urethra but also of the bladder—and often of other viscera as well—and a tear of the rectum as well as of its sphincter system. There is always tremendous loss of blood, variable loss of skin, and widespread crushing of adductors and glutei. In the 11 patients with this combined injury which the writer has seen the cause of the damage has been crushing by some enormous

object: one man was run over by a tank transporter, another injured by the falling of a number of huge concrete blocks used in the construction of a swimming pool.

In these injuries the first duty is to stop the bleeding and resuscitate the patient. No doubt in former times these patients must have died before they could be rescued from the scene of the accident. Today, with efficient ambulance and resuscitation teams, more of them will survive. The next major hazard is gas gangrene—for the gross soft tissue necrosis combined with the wound in the rectum invites clostridial infection. As soon as possible a defunctioning colostomy should be established and the lower bowel irrigated clear. No attempt should be made to effect primary suture. Since the laceration of the lower urinary tract often involves the side of the bladder, a supra-pubic cystostomy may not be enough to keep the perineal wound dry and, as soon as the general condition of the patient allows it, an ileal conduit should be made to divert the urine away from the wound, which otherwise cannot be expected to heal.

#### *In females*

Curiously little attention has been given to injuries of the urethra in women after fractures of the pelvis. In the writer's series of 333 fractures of the pelvis (Glass *et al.*, 1978) 157 were in women. As might be expected, many of these were trivial osteoporotic fractures without any urological difficulty. In 14 there were very extensive multiple injuries, generally from traffic accidents, and a catheter was passed in order to monitor urinary output for the purposes of resuscitation: of these, 3 died of their injuries and one survived with gas gangrene of a leg. In 4 the haematuria was ignored: it was trivial, and the patients had no other symptoms. Eight women had severe multiple soft tissue injuries complicating the pelvic fractures. The rectum, vagina and urethra were all lacerated in one patient; in 3, the vagina only was injured and in the remaining 4 patients the bladder and urethra were torn to a variable extent. On each occasion the lacerations were sutured and catheter drainage was provided. When the rectum was lacerated a colostomy was fashioned to protect it. One patient fell through a 4th floor window and sustained a massive pelvic haematoma with wide disruption of the pelvis. The laceration of the vagina split open the entire length of the urethra as far as the neck of the bladder. The state of the local soft tissues prevented primary repair and when the catheter was removed she was completely incontinent from the total loss of her urethra. Reconstruction of the lost urethra restored her continence.

Incontinence has so many aetiologies in women that it is difficult to interpret the finding that in the

patients who had no obvious urethral injury 4 became incontinent after the fractured pelvis. In 2 this was only bed-wetting; in 2 others there was stress incontinence as well. It seems possible that this was related to injury to the pelvic parasympathetic innervation, and it recalls the finding that among the males there were 2 who complained of impotence after fractures of the pelvis without urethral injury.

#### *Inflammatory strictures*

##### *In males*

On reviewing the urethroplasty cases in whom the opportunity has arisen to see the extent and form taken by inflammatory strictures, one is struck by the fact that there seem to be 2 kinds of inflammatory

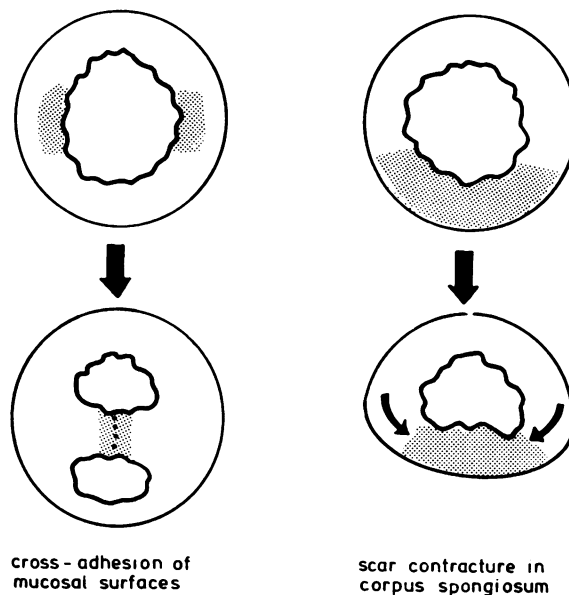


FIG. 13. Different forms of inflammatory strictures—cross adhesion, and cicatrix in the corpus spongiosum which narrows the lumen.

stenoses (Fig. 13) those which consist of a cross-adhesion between the mucosal surfaces, and those which are made up of a full thickness scar of the corpus spongiosum. The inflammation is obviously more often caused by gonococcal or non-specific urethritis than by any other agency and, even in Britain, the majority of stricture patients admit to this antecedent illness. Elsewhere gonorrhoea is even more prevalent. New cases of gonorrhoea treated in Britain seldom go on to form a stricture, and most of the writer's patients suffered their illness in other countries or before the sulphonamide era.

The sites of predilection for post-gonococcal

stricture exactly reflect the richness with which the urethra is supplied with para-urethral glands (Singh and Blandy, 1976). No glands are to be discovered in the membranous urethra, but the proximal bulbar urethra have a rich distribution of glands extending deeply into the corpus spongiosum, and are distributed circumferentially all around the urethra. They are less common at the peno-scrotal junction, and become abundant again near the glans. In gonorrhoea there are two clinical phases—

‘A man shall have an abundant discharge from the urethra, considerable pain, and even chordee and if he should get a fever, the discharge disappears, the pain ceases, and he will be entirely free from all symptoms of the disease for a period of from 17 to 20 days; as soon however as he begins to recover from his fever, the discharge of matter will be resumed, the pain and chordee will return and a long time may elapse before the disease will be removed’ (Castle, 1831).

The clinical features of the stricture may be delayed for many years: usually 3 to 10 years after the first attack of gonorrhoea (Kidd, 1910). The pathogenesis was carefully studied by Kidd who wrote:

‘The gonococcus or secondary contaminating bacteria that follow in its train tend to linger on indefinitely at the end of an attack of acute urethritis in two situations. (1) In localised hyperaemic patches formed by subendothelial collections of round cells and bacteria in the penile and bulbous urethra. (2) In subendothelial patches around the mouths and walls of the crypts and mucous glands of the penile and bulbous urethra. These patches may take many months or even years to heal and in the process of healing, spindle-cells appear and lay down fibrillar connective tissue, which as it grows thicker also shrinks like scar-tissue in any part of the body’ (Kidd, 1910).

Added to this fibrosis, Singh considers that there are in effect localized ruptures of abscesses in the para-urethral glands, and that once a stricture has formed, it is made both longer and more severe by build-up of pressure proximal to the narrow zone, allowing extravasation of urine through the para-urethral glands into the cavernous tissue of the bulb. It was this mechanism which he considered to be mainly responsible for the well known slow march of a bulbar stricture towards the prostate which is seen in serial urethrograms on patients undergoing conservative therapy by intermittent bouginage. In experiments in the rat he found that urinary diversion protected the corpus spongiosum of the rat from scarring (Singh and Blandy, 1976).

The risk of extravasation into the soft tissue of the corpus spongiosum, and the effect on the tissues of continuing infection deeply seated in the para-urethral glands probably explains the difference in the incidence of gonococcal strictures in Britain as compared with Africa. In Britain, free and prompt treatment is usually obtained early in the disease before Kidd’s sub-endothelial plaques have had time to collect, and before para-urethral glands can become infected. The purely superficial inflammation of the mucosa will resolve with effective antibiotic medication. No stenosis therefore forms, and there is no added factor of proximal extravasation to hasten the development of the stricture.

Other infective agents also give rise to urethral stricture. Little is said about the presence of schistosomiasis in the urethra, but if one takes tissue for biopsy at the time of urethroplasty on cases operated upon in Egypt and Africa, the characteristic ova of *Schistosoma haematobium* will often be found. They are in fact present throughout the organs of the pelvis, and it would be surprising if they were absent from the urethra. What role they play in the aetiology of the notoriously dense scar tissue of urethral strictures in the tropics remains a relatively unexplored field for future research.

Organisms of the *Chlamydia* group—a large virus—are responsible for much non-gonococcal urethritis, and Oates (1976) has reviewed the evidence that *Chlamydia* urethritis may cause urethral strictures. In the tropics where the closely-related organism of lymphogranuloma venereum causes so widespread and such severe damage to rectum and vulva, it is likely that the urethra is involved as well by the granuloma. By the time the watering-can perineum is investigated secondary infection, sinuses and abscesses make it virtually impossible to incriminate a virus as the prime cause of the mischief. Considering how long it took surgeons to distinguish gonorrhoea from syphilis it is no matter for surprise that the exact cause of purulent urethritis and stricture resists discovery.

Tuberculosis is often overlooked as a cause of urethral stricture. In a review of the literature, Symes and Blandy (1973) could find only 16 previous reports, and added 5 of their own. In all of these save one the stricture was complicated by multiple fistulae and abscesses which were secondarily infected, thereby making the diagnosis of tuberculosis very difficult. In his extensive experience of genito-urinary tuberculosis, Gow (1976b) could recall only 2 cases involving the urethra.

Balanitis xerotica obliterans, or lichen sclerosus et atrophicus as learned dermatologists prefer, has no known cause. It is characterized by oedema and homogenization of the superficial dermal collagen and hyperkeratosis of the epidermis (Bainbridge,



Whittaker and Shepherd, 1971). It has a predilection for the prepuce and skin of the glans penis, which may become adherent, and then shrink until the external meatus is quite obliterated. In their review of the writer's cases, Bainbridge *et al.* emphasized the risk of urinary outflow obstruction but could not find any evidence of involvement of the urethra except just inside the external meatus. However, since then, the writer has seen 4 other patients, in whom balanitis xerotica obliterans occurred in the skin used for urethroplasty, hairy side facing the urine. In 2, the skin shrank and the stricture recurred. In one, the skin changes followed after radiotherapy for a more distally situated cancer, and its treatment with urethroplasty. In one, a squamous cancer developed near the patch of balanitis xerotica in skin used for urethroplasty. One cannot help accepting Staff's (1970) suggestion that the condition is associated with stricture in some way. Mallo *et al.* (1978) reported 5 such cases, and it is disconcerting that one had an associated squamous-cell carcinoma.

In small boys another unusual inflammation may cause the clinical features of urethritis, sometimes with a bloody urethral discharge. Fifteen such cases were reviewed by Williams and Mikhael (1971). One such case was seen by the writer and investigated without finding the cause for a considerable time, until urethroscopy demonstrated small urethral granulomata, which were coagulated with diathermy. Seven years later a stricture was found in the urethral bulb at the site of these granulomata. Possibly some of the 'congenital' urethral strictures in this part of the urethra may really be of this type.

#### *In females*

If gonorrhoea is so common, and so often to be found in the female urethra, it is odd that it should never cause an inflammatory stricture. This diagnosis is never made, although urologists have never been slow to seize an excuse to dilate the urethra of the female. The female urethra is provided with innumerable glands, and it is well known that symptomless infection in these glands may be one way in which the disease is transmitted. One would expect them to rupture from time to time into the spongy tissue of the female urethra, causing a scar similar to that seen in the male corpus spongiosum, but they do not seem to do so. Small abscesses in these glands are often seen; they form exquisitely painful swellings along the course of the urethra from which pus can be expressed or let out by incision. On culture it will prove, as a rule, to be an unremarkable *Staphylococcus*. With healing, these small abscesses may leave small sacculi in the urethra, seldom a stricture. It is perhaps unwise to speculate about the rarity of stenosis in these urethrae, but Singh's

observations (Singh and Blandy, 1976) on the role of extravasation of urine may be relevant: in women there is nothing to cause retention, and no reason for urine to build up pressure upstream of the inflamed glands.

Equally, it is odd that *Chlamydia* has not been incriminated as a cause of inflammatory stenosis of the female urethra, and yet to the writer's knowledge this seems to have escaped the attention of the army of urologists seeking an excuse to dilate the female urethra on one pretext or another. Its close relation, the organism which causes lymphogranuloma venereum, gives rise to granulomata in the lymphatics of the pelvis, as well as ulceration and mucosal lesions in the vulva and colon. Lymphoedema, fistulae, and secondary infection with other organisms make up the dreadful picture called 'esthiomène' in the tropics, but as far as the writer knows, a true stenosis of the urethra has not yet been identified as due to this organism.

In Africa, where schistosomiasis is prevalent, the female urethra is typically the site of polypoid and granulomatous lesions, often giving rise to bizarre swellings in the vulva. Along with the other pelvic contents the urethra suffers the fibrotic changes provoked by the presence of the ova, dead or alive.

#### *Malignant strictures*

##### *In the male*

The subject of carcinoma of the male urethra is too large to be covered in this article, but it cannot be entirely omitted from a discussion of stricture. In males there are 2 kinds of urethral carcinoma: the common variety (in Britain) descends from the bladder, and is a transitional cell carcinomatous implant, probably seeded on the lining of the urethra by repeated endoscopy. It may also occur *de novo* in the urethra, in patients with a generalized pre-cancerous change in their urinary tract; estimates of this risk have varied from one writer to another. In a careful analysis involving 174 patients, Raz *et al.* (1978) concluded that about 7% had carcinoma in the urethra in association with carcinoma in the bladder, and a further 6% or so had *in situ* carcinoma or pre-cancerous metaplasia in the lining of the urethra. This has been used as an argument for regularly removing the urethra along with the bladder at cystectomy for bladder cancer. Ashworth (1956) studying 1307 cases put the risk somewhat lower, at approximately 4%. From the point of view of following-up patients with multiple and recurrent bladder tumours, it is obviously necessary to look at the urethra each time the bladder is examined, but if a tumour is found in the urethra, and if it is removed for biopsy and then the base coagulated, there is a significant chance that this treatment will give rise to a stricture.

Not only may neoplasm thus initiate stricture, but it may follow long-standing urethral stricture after an interval, usually of many years. The writer has now seen 5 cases of carcinoma of the urethra, always squamous in patients attending the stricture clinic: in 3, the stricture was at the meatus, and the patients had been attending for regular dilatation for more than 10 years; in one, it was a bulbar gonococcal stricture of a lifetime's duration, and when the carcinoma appeared, it involved the whole bladder, and had even grown along the track of an ancient supra-pubic cystostomy incision. The most recent case is one referred to above, with carcinoma associated with balanitis xerotica 20 years after a series of attempts to perform urethroplasty.

In Africa, where stricture is so prevalent, Dodge (1964) reports that carcinoma of the urethra is a common type of malignancy in the male, and in any African hospital one can see tragic examples of the watering-can perineum in which tell-tale woody induration informs the experienced local surgeon of underlying malignancy. Pointon and Poole-Wilson (1968) noted that 32 of their 142 cases were inoperable by virtue of widespread lymphatic spread when first seen. In Kaplan Bulkley and Grayhack's series (1976), 81 of their 232 cases followed a stricture (35%); in that of Kirkman (1961) the proportion was even higher (52%).

Squamous cell cancers also occur in women in the urethra. The writer has recently seen a tragic case in a young woman, treated over a period of 3 years for a supposedly trivial 'urethral syndrome' in whom a florid squamous cell carcinoma, invading the pubis was revealed on endoscopy, which had until then been omitted. In some of these women the appearance mimics a 'caruncle', a diagnosis which should never be made without confirmatory histology (Blandy, 1976b). More sinister, in women, are adenocarcinomas which seem to take their origin in the proximal inch of the urethra, near the neck of the bladder. Although it is tempting to imagine that these might be locally resectable or would respond to radiotherapy, in fact they have a poor prognosis. In one of the author's patients the tumour arose from within the wall of a diverticulum.

#### *Degenerative disorders of the urethra*

Unless one can include balanitis xerotica obliterans in this category—and the writer has one patient who was only 8 years old when it began—there are no definite and distinct changes in the urethra which in males can be attributed to old age. In women there is a well recognized 'senile' change which affects the skin of the vulva and urethral meatus, gradually coming on within a few years of the menopause or oophorectomy. Since the urethra forms part of this same skin area, it is involved in the atrophic changes, becoming

shorter, narrower, less flexible and perhaps more readily infected. Here one can definitely identify a stenosis, both to the bougie à boule and by means of the flowmeter, and here there seems beyond doubt to be a place for dilatation (see below).

#### **Clinical features of urethral stricture**

The main symptom which brings the patient to his doctor is difficulty in voiding:

'An individual having permanent stricture, first observes a few drops of water remain after the whole seems to have been discharged, then notices a fine spiral or divided stream and, lastly, discharges his water by drops only. In this last state, for the purpose of facilitating the escape of the urine and preventing its being retained by the lacunae of the urethra, he draws out the penis with considerable force' (Castle, 1831).

Retention of urine upstream of the stricture causes him to dribble urine down his trousers: eventually he develops supra-pubic fullness and discomfort, secondary infection in the residual urine in the bladder and, if nothing is done, there may be acute retention, or the evidence of upper tract dilatation in the form of hydronephrosis and perhaps uraemia.

Sometimes hypertension is the feature which is first noticed by his doctor, and not until a complete examination is done is it evident that there is prolonged bladder outflow obstruction. In elderly patients, these features of urinary obstruction caused by a stricture cannot be distinguished from those of prostatic enlargement.

Acute retention is not very often caused by a stricture in Britain, perhaps because severe and neglected strictures are not common, but they still do occur, and the old story that a stricture never gave rise to acute retention is untrue.

In strictures of long-standing there is a shortening of the corpus spongiosum, which gives rise to a chronic chordee, the penis being bent as if by the string of a bow when erect. In one patient this deformity caused him to desist from intercourse which he cheerfully resumed 47 years afterwards when the stricture and its chordee had been corrected by urethroplasty (this patient delightedly informed the writer of this unlooked-for benefit of the operation in a picture postcard mailed in Paris).

Often it is the complications of urethral stricture which bring the patient to hospital. Extravasation and the development of a perineal abscess is one very severe complication. In former days it was a regular feature of the late stages of untreated gonorrhoea. Today the patient presents in the emergency room with a huge perineal extravasation,

already secondarily infected. He may not be aware—or more often pretends not to be aware—of previous strictures. A peri-urethral abscess has ruptured into the soft tissues of the scrotum.

'The tissues of the perinaeum, scrotum, penis and abdomen are distended with fluid, hot, dusky-red and tender. In advanced cases green or black gangrenous subcutaneous sloughs may show through the skin, and the presence of gas is revealed by a sensation of emphysematous crackling or the appearance of gaseous bullae. Last of all the subcutaneous tissue and skin may slough clean away, leaving the testicles and penis denuded and covered with unhealthy granulation tissue' (Kidd, 1910).

Such patients still present themselves to the emergency room, although they are usually seen earlier in the disease, and before gangrene has supervened or the urine has made its way to the surface through fistulae to form the watering can perineum. In Africa, experienced surgeons tell of scores of such patients.

To a specialized urological department, other complications are referred: the commonest is the urinary fistula, which fails to heal because there is an untreated stricture downstream of the internal opening of the fistula. Others have pockets lined with epithelium, often containing calculi. Many are referred with a supra-pubic tube which has been in position for several years on the supposition that nothing can be done for the stricture (it should be noted that the bladder will recover its function many years after a supra-pubic tube has been *in situ*). In others, some form of urethroplasty has been started elsewhere and abandoned (the older versions of skin inlay urethroplasty were extremely difficult to perform).

Occasionally a patient is referred from the infertility clinic, a characteristic small volume of ejaculate being obtained and a history is extracted of a sensation of an obstructed emission.

Perhaps the most dangerous complication of all is septicaemia, especially when the patient has been in hospital for any length of time, and has been treated for any period with broad spectrum antibiotics, so that the bowel has become colonized with resistant strains of *Pseudomonas* or *Klebsiella*. Any urethral instrument may then force organisms into the bloodstream, which will be followed by septicaemic shock, possibly (as in 2 of the author's patients) by the late development of metastatic abscess in vertebrae or other bones.

In men, unless there are obvious abscesses, fistulae, or a marked chordee, there may be no overt physical signs, except when prolonged in-

duration gives rise to a palpable thickening in the urethra.

In women the clinical features of urethral stricture which is genuine are what one might expect. There is a difficulty in voiding, sometimes amounting to acute retention. With the development of some residual urine there may be infection and urgency, occasionally amounting to urge incontinence. If there is a definite infection in the para-urethral glands associated with the stenosis of the urethra, the patient may complain of pain radiating to the vulva and thigh. Flow rate measurements will confirm the restricted rate of flow, and the passage of a bougie à boule will confirm that the urethra is indeed very narrow. On inspection, since the majority of true urethral strictures occur in women with atrophic changes in the vulva, this will be evident. The vulval skin is dry and shiny, whitish in places, and sometimes excoriated from the irritation which is frequently a feature of this distressing condition. If the patient has been given broad spectrum antibiotics on the supposition that her symptoms are due to a microbial infection, matters may be made worse by the appearance of unusual organisms and yeasts in the vulva to make it and the adjacent urethra even more sore. One usually learns little on vaginal examination, although sometimes the urethra is slightly tender to palpation and, in women with associated infection in distended para-urethral glands, purulent material (which should be cultured) can be expressed.

#### The investigation of a urethral stricture

The time-honoured clinical observation of the patient passing his water gives the observer more information than can be obtained from any electronic machine, since he is able to watch more than the patient's flow. However, the invaluable objective evidence of the flow rate provides a way of measuring and documenting the severity of the outflow obstruction which avoids bias and subjective error. Smith (1976) has reviewed the urodynamic basis of many of the contemporary methods of assessing outflow obstruction and Zinner, Ritter and Sterling (1976) have amplified some of the underlying physical assumptions upon which modern urodynamic theory is based. For the simple surgeon it is as well to bear in mind some of the sources of error of these techniques: unless the volume passed is large, the flow rate may be deceptively low; unless the urethral calibre has been reduced to something rather less than 11 Ch there may be no detectable diminution in the rate of flow. While this may be safe, it can only be safe provided the surgeon can be certain that the urethra will not shrink any smaller.

Nevertheless, in modern urological practice regular review of flow rates obtained under more or

less identical conditions can be a useful way of monitoring the patient's progress.

The traditional way of evaluating the calibre of the urethra was with the bougie à boule which, in various forms, is still part of every-day urological practice. It is clearly open to the objection that there is necessarily an observer error built into any measurement which relies upon the sensation of the boule slipping past the stricture. Using curved bougies of more traditional shape with an olivary end one can both judge the calibre of the stricture and dilate it.

In patients who are being considered for an operation on the urethra, it is necessary to have more information than can be provided from the flowmeter or the passage of a bougie, and the contemporary development of urethrography now makes it possible to depict the urethra with considerable accuracy.

One may use either a thin water-soluble contrast medium or a thicker viscous gel. Each has advantages and drawbacks. Unless a viscous contrast medium is used, it is not possible to distend the urethra fully, or show the length and irregularity of a stricture. By the same token, if the stricture is very tight, the viscous contrast medium does not pass upstream of the stenosis, and will not give a helpful picture of the state of affairs higher up in the urethra. Many patients dislike urethrography: they say the contrast medium is irritating and the investigation unpleasant.

Water-soluble contrast medium runs so freely up the urethra and into the bladder that the narrow but normal undistended urethra may be mistaken for a stricture. Filling of peri-urethral veins occurs with either form of contrast medium and, although it is undoubtedly safer to use the water-soluble material, the resulting radiographs are more often obscured by irrelevant extravasation and intravenous filling. Exaggeration of the dimensions of the posterior urethra can cause the inexperienced surgeon to have misgivings; the impression of the normal external sphincter may be misinterpreted by an inexperienced radiologist as a stricture. Filling of the prostatic ducts is often seen when there has been prolonged urethral obstruction and filling of the ducts of Cowper can be mistaken for a false passage. Perhaps the most important single mistake, in interpreting urethrograms, is to assume that the diseased urethra ends where the narrow segment ends in the radiograph.

The damage to the urethra is often much more extensive. It is for this reason above all others that the writer prefers techniques of urethroplasty which can be adapted to the circumstances found at operation.

Viscous contrast medium should not be used for

urethrography within 10 to 14 days of a recent difficult bouginage, or the irritating contrast medium may be forced out into the peri-urethral tissues and cause an inflammatory phlegmon. If a urethrogram is absolutely necessary, it should be made with water-soluble contrast.

Today, the investigation of the patient with a severe stricture is incomplete without an excretion urogram. Often coincident infection is accompanied by stenoses, diverticula, or calculi in the upper tract. Often the bladder is so damaged by prolonged outflow obstruction that diverticula in its wall require removal. Stones are often present when a catheter has been left in supra-pubically for several years.

Finally, it is always necessary to look into the urethra as far as one can go. Thanks to modern end-viewing rod-lens telescopes a good view may be obtained of urethral strictures and, in the author's practice, the final decision as to the best way to manage the stricture is only reached after a careful reconnaissance at which, if necessary, an attempt is made to deal with the stricture by less radical means than urethroplasty. Urethral strictures fall into different categories and by no means all require the same kind of approach.

### **Management of strictures in the male**

#### *Strictures of the external urinary meatus*

Whether these are caused by scarring after infantile circumcision, balanitis xerotica obliterans, diathermy of meatal condylomata acuminata, surgery or radiotherapy, it is almost always worthwhile attempting to see if they can be remedied by intermittent dilatation in the first instance.

For strictures of the external meatus one uses the straight dilators of Wyndham Powell. If the stricture stretches up easily, as is the rule in those which occur after prostatectomy and operations on the bladder, one may persevere with dilatation. No controlled studies exist to show whether the addition of topical steroids to the lubricant on the dilator, or applied by the patient afterwards, make any difference to the response of these typically soft and easily treated stenoses, but the local inflammation is sometimes lessened by applying triamcinolone or clobetasol cream.

Some of these strictures do not yield easily; instead they seem to split as if a crust had given way. The split heals together as tight as before within 10 to 14 days. This is the rule in post-amputation strictures, and those which follow balanitis xerotica obliterans and radiotherapy for carcinoma of the penis. It is also the finding in patients with very firm strictures following circumcision.

The alternative is to try to slit up the meatus (meatotomy), and this is worth while in very short

strictures seen after a meatal ulcer. If meatotomy is done, the patient needs to be lent a Wyndham-Powell bougie to pass regularly for the first 3 weeks to make sure the edges of the little incision do not stick together.

More often than not meatotomy is futile in patients with balanitis xerotica: the narrowing quickly returns, and the diseased zone extends for a centimetre or so down the urethra. For these patients the little operation of 'meatoplasty' gives a more permanent cure. This was devised 15 years ago (Blandy and Tresidder, 1967) and the writer has recorded 40 patients since the first one was operated upon in 1964 with only 2 recurrences. One tiresome snag of the operation is that the natural choke of the male urethra is converted to the trumpet of the blunderbuss, and the patient has to teach himself to

shoot straight all over again. By taking special care in the design of the U-shaped flap (Figs 14, 15) this difficulty can be mitigated, but not really avoided altogether. Nothing seems to imitate exactly the natural design of the urethra.

#### *Strictures of the anterior urethra*

Many of these have been the legacy of gonorrhoea or non-specific infection; some follow iatrogenic trauma, and in many (14% of the total) the cause of the stricture is unknown. Some of these strictures are single and appear quite short in the urethrogram. Others are multiple, and it seems from the radiograph that the urethra in between is healthy, an appearance which may be very misleading. Easiest of all to deal with are those which occur in the shaft of the penis where the pendulous part of the urethra

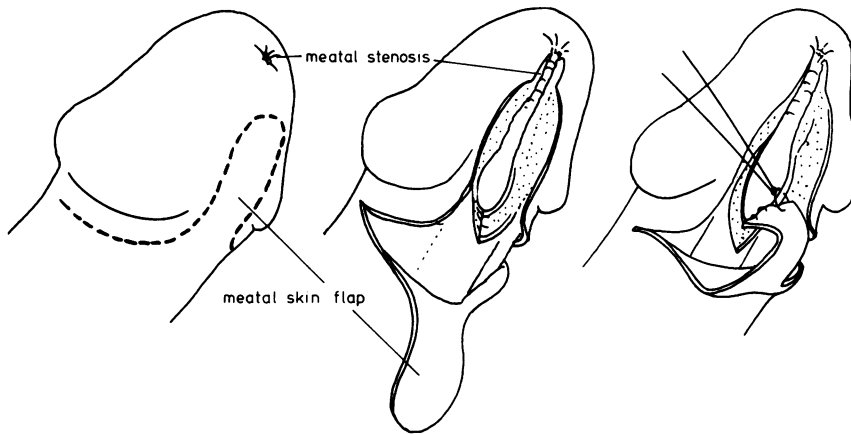


FIG. 14. Meatoplasty: a  $\Omega$ -shaped flap is taken from the underside of the penis, and the stricture slit open into healthy urethra. The tongue of skin is then sewn into the defect.

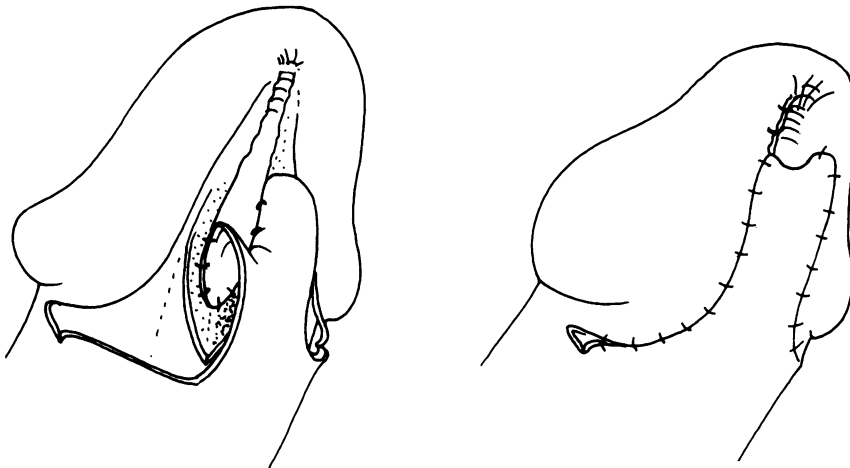


FIG. 15. Completion of meatoplasty: the narrow part is permanently widened.

abuts on the swelling of the edge of the scrotum, where there is always plenty of skin with which to fashion a patch for the narrow segment. These are the strictures which seldom require any surgical intervention. Often they are found after some urological operation and, like soft strictures at the external meatus, they respond easily to regular gentle dilatation.

In patients with more dense fibrosis of the corpus spongiosum, it may take much more time and trouble before the calibre of the urethra is thoroughly opened out, and there is room for argument in each case as to the choice of regular bouginage or a urethroplasty. No plain answer can be supplied which fits every case. On the one hand if the patient is destined to return to a primitive area where the local practitioner has neither the training nor the bougies with which to afford regular dilatation, then the patient is better off with a urethroplasty which probably carries less than 7% chance of restenosis. On the other hand, the man living in London or New York who can have his stricture skilfully dilated by a well trained surgeon for the rest of his life need not undergo the risks of a urethroplasty. So much depends on the skill and interest of the surgeon who is to look after the patient. No single part of the training of the young urologist is perhaps so important—or so often neglected—as the way he is taught to pass a bougie. When the author was newly qualified it was his privilege to work in a large venereal disease clinic where the routine test of cure of the patient with urethritis included the passage of a curved steel sound up the unanaesthetized urethra. One soon learned the truth of the old adage that gentleness and good manners make the best anaesthetic:

'caution is very necessary to be observed in the cure of strictures of the urethra, in which case the proper intention is gradually to dilate the passage, and to procure an increased discharge of mucus from the lacunae; this should always be done gently, and by means which give as little pain as possible; whatever irritates or gives pain will certainly do mischief, will add to the obstruction, and increase the dysury' (Pott, 1779).

Things are easier for the young surgeon today: safe and effective local anaesthesia is available in the form of proprietary gels containing 1% lignocaine and 0.25% chlorhexidine which both anaesthetize and perhaps go some way to sterilize the lumen of the urethra. The urethra is filled with the gel and closed with a penile clamp, and plenty of time (at least 4 min by the clock) allowed for the local anaesthetic to take effect.

Innumerable different shapes and forms of bougie and sound are available to the surgeon of today, and most of them go under half-a-dozen different eponyms. In equipping a surgical department one must have a minimum of 5 sets of bougie. First, there are the modern descendants of the old catgut and whalebone instruments—the filiform guides. They must be smooth and they must be strong. Above all they must be sterile, i.e. autoclaved, and not steeped in some mysterious solution of doubtful antibacterial efficacy.

These guides are fitted with female screws into which followers of graduated sizes can be fixed. One needs followers which are flexible (today these are generally made of plastic which can be properly sterilized) but a plastic flexible bougie imparts only an imperfect sense of touch, and in negotiating more difficult strictures one needs a more rigid follower, with a curve, made of stainless steel.

One needs a set of graduated sizes of flexible bougies with an olivary-ended tip capable of being sterilized in a reliable fashion (hence not made of gum-elastic). One needs a set of curved steel bougies—the writer prefers the short hockey-stick curve designed by Otis and introduced to Britain by Clutton (after whom it is named in this country). A few surgeons prefer a sound with a more open curve, modified by Buckston Browne from those used by his chief, Henry Thompson. Others like the curved bougie with an olivary end—said to have been designed by Lister (Lytton, 1976).

In a modern department, all these instruments should be clearly marked with their size in the Charrière scale, i.e. circumference in millimetres. It is better to refer to this as 'Charrière' rather than 'French' since the French themselves use the Béniqué scale as often as not for bougies of smaller size.

For the new patient with the newly-diagnosed stricture it is the writer's practice nowadays to examine the face of the stricture first with the endoscope and, if there is a small hole, pass a filiform guide into it under direct vision. Withdrawing the endoscope over the filiform, with the aid of an adapter of appropriate size, a series of followers are attached and the stricture progressively dilated.

For the patient who comes up with a known stricture, a bougie a little smaller than the one previously used is selected, preferably a steel Clutton-Otis type, which provides a more delicate sense of touch (and can be reliably autoclaved). This is then allowed to fall down the urethra more or less under its own weight:

'You should introduce a bougie, letting it steal gently along the urinary passage, and when it arrives at the strictured part, there let it rest

for a short time: after this you should gradually push it forward, using only a very slight force, but continuing that force until you have succeeded in passing the stricture. Let the bougie rest for a minute or two in the strictured part, and then withdraw it . . . ' (Castle, 1831).

At each instrumentation great care is taken not to overstretch the urethra, not to tear it, and not to cause pain or bleeding. As a good rule of thumb the intervals between each bouginage can be doubled, provided each occasion goes smoothly and the stricture yields easily without discomfort. Eventually one reaches the time when the patient is coming again only every 8 to 12 months. If this happy state of affairs is reached, as is often the case with the short stricture in the anterior urethra, then there is plainly no indication for meddlesome urethroplasty. But this is not always the position.

Dilatation needs certain skills and training and in an ideal world the patient should be able to know that he will return to the same hand that passed the bougie on the preceding occasion. This cannot always be arranged and, perhaps especially in a busy teaching hospital, it is commonplace for the 'new assistant syndrome' to be observed: i.e. for months the same handwriting records that a 20/24 Ch bougie 'fell in', and then the handwriting changes and the notes are full of details of pain, of bleeding, of rigors, and perhaps an admission for retention of urine. If this is true of a centre where only well trained assistants are employed, how much more

true is it of hospitals overseas where strictures are more common and more difficult.

In this system of dilatation of a stricture emphasis for centuries has been laid on gentleness and patience, and in making haste slowly. But ever since the days of Ambroise Paré surgeons have wondered whether it might not be possible to hasten the process by slitting the stricture from within. This important question is of interest today, for it is now very fashionable to treat urethral strictures by internal urethrotomy, especially since the precise and beautiful urethrotome of Storz (Fig. 16) has been made available. This instrument permits the surgeon to slit the stricture under direct vision using the Hopkins rod-lens and brilliant illumination, in a stream of clear saline. But urethrotomy is not changed in principle merely by changing the knife, it still consists of an incision into the stricture, and the essential problem is how to stop the raw edges from sticking together again (Fig. 17). To prevent this, some writers have left catheters of different materials in the urethra and for more or less prolonged periods (Engel, Wise and Whitaker, 1972), some have instilled steroids in the hope of preventing fibrosis (Matouschek, 1978) others have enjoyed a regime of autodilatation on the patient, instructing him to void against the resistance formed by pinching his urethra.

The writer has used the technique in one form or another in 49 patients: 25 are successful, in that they are coming up for occasional dilatation or perhaps calibration; in 24 cases the result is unsatisfactory,

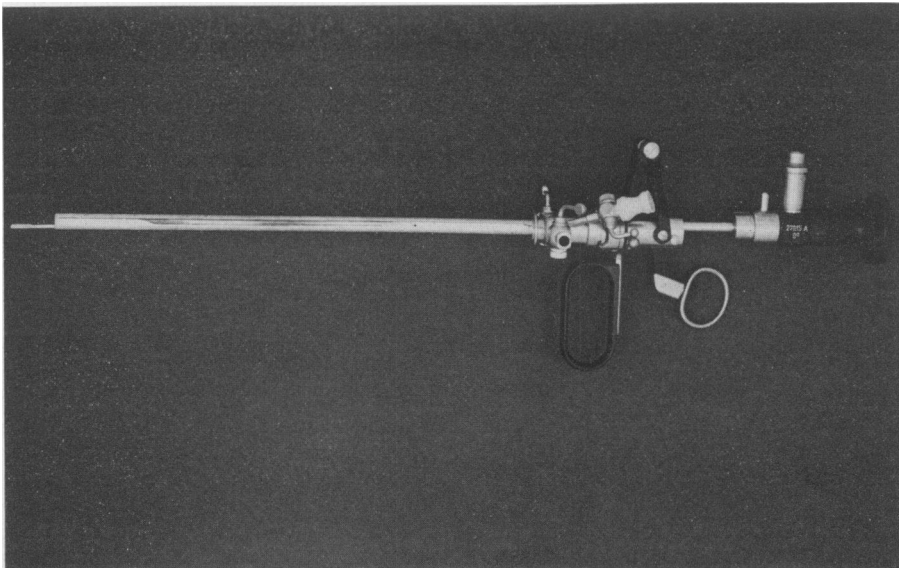


FIG. 16. Visual cold-knife urethrotome (Courtesy Karl Storz KG).

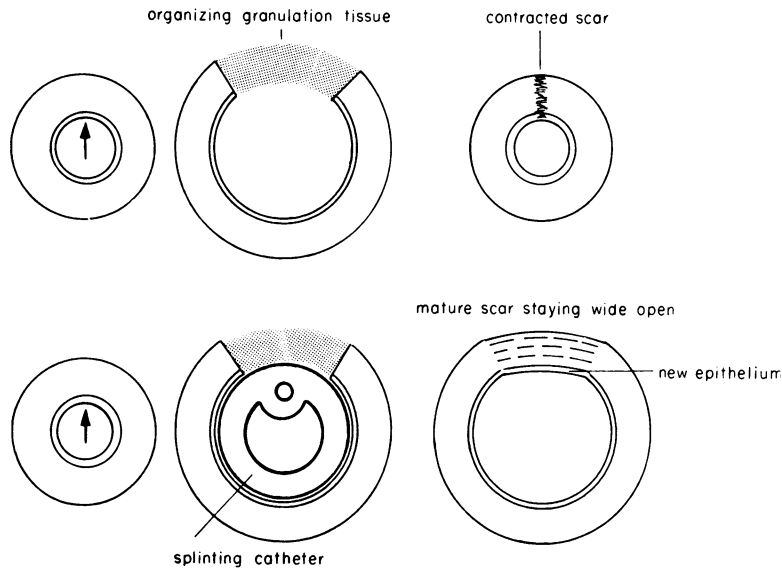


FIG. 17. Cutting the stricture leaves a gap: the kernel of the problem in internal urethrotomy is how to stop the scar from shrinking. A splinting catheter may keep it widely open until the scar tissue is mature.

and the stricture has been dealt with by urethroplasty. Others have had better success: Lipsky and Hubmer (1977), in 32 cases followed-up for a relatively short time, had success in 17 (53%); Kirchheim, Tremann and Ansell (1978), in a 6-month follow-up of 20 cases claimed 16 good results (80%); Matouschek (1978) in 547 patients, very carefully detailed, had a good result in 79%—evaluated by the flowmeter and urethrogram. At present there seems to be no easy way to predict which patient will do well and which will do badly. In some, a deep incision through the stricture with the bee-sting electrode or the Storz cold knife is followed by the appearance down the urethroscope of a wide groove as if the urethra has been made permanently larger. The essential difficulty is to prevent the underlying scar from contracting as the urethral mucosa covers the gap. In this connection, and applying the principles learned so long ago by the plastic surgeons, Pettersson, Asklin and Bratt (1978) have made the intelligent suggestion that split skin should be applied to the raw gap left by the urethrotome. The split skin is simply rolled up on a catheter and left in the urethra, in the hope that the living skin will adhere to the raw tissue of the urethra and the rest will come away when the catheter is removed after an appropriate interval. They claim good results in 4 cases followed-up from 4 months to one year. The method ought to work and it will be of great interest to see whether it has consistently good results. One source of doubt concerns the ever-present hazard of infection, which is almost

invariably present in these patients and which is a severe handicap to successful split-skin grafting elsewhere.

The writer prefers to use the urethrotome as a way to speed up the process of bouginage in selected and difficult cases where the strictures are long and tortuous and ordinary passage of a sound difficult and painful. For the usual patient, a filiform guide is passed through the lumen of the stricture, either blindly—having first given the tip of the guide a little dog-leg bend to make it easier to get into an eccentric opening—or under direct vision through an endoscope. Having stretched the hole slightly, one passes a modified Otis urethrotome and directs the blade of the knife against the stricture, cutting it through only where it is tight. The incision is made in the 12 o'clock midline (the terms dorsal and ventral being often confused in the penis). The narrow part is cut through. A silicone rubber catheter is passed and left in the urethra for 3 or 4 weeks. The patient then returns, and the stricture is calibrated with the regular passage of bougies. There is nothing new in this use of the urethrotome, and it can be very useful, avoiding endless outpatient dilatations and (in some 25 out of 49 of the author's cases) preventing any need for a urethroplasty.

Unfortunately, by no means all patients will respond so well to the bougie with or without internal urethrotomy. Septicaemia may strike out of the blue, and if a man develops septic shock, if he has once had a rigor after bouginage, the risk of a



second bacteraemia being more serious in its consequences must be born in mind. 'Patients seldom if ever die in a rigor' (Kidd, 1910)—but they do sometimes. Often all that is needed is a small covering dose of an antimicrobial; but when rigors are frequent, one should seriously be considering a more permanent solution to the trouble.

Other patients find the passage of the bougie so painful or so repugnant that they make any excuse to default, and leave things until the stricture is so tight that acute retention ensues or extravasation takes place. In some, the bouginage is not particularly difficult or painful, but it has to be done very often if the stricture is to be kept patent, and the unfortunate patient must return every 2 or 3 weeks for instrumentation. For such patients urethroplasty offers a better solution (Blandy, 1976a). Even when bouginage seems to be going along successfully it is important to recognize the in-built hazards and complications of a method of treatment which has

TABLE 2. Complications in 141 strictures treated by dilatation

|           |                 | No. | %       |
|-----------|-----------------|-----|---------|
| Renal     | pyelonephritis  | 1   | 5 3.5   |
|           | hydronephrosis  | 1   |         |
|           | staghorn stone  | 1   |         |
|           | nephrectomy     | 2   |         |
| Bladder   | diverticula     | 3   | 25 17.7 |
|           | calculi         | 2   |         |
|           | acute retention | 20  |         |
| Urethra   | diverticulum    | 1   | 24 17.0 |
|           | abscess         | 5   |         |
|           | false passage   | 13  |         |
|           | extravasation   | 3   |         |
| Infection | bacteraemia     | 6   | 18 12.8 |
|           | endocarditis    | 1   |         |
|           | epididymitis    | 11  |         |
| Total     |                 | 72  | 51.1    |

to be repeated so often (Table 2). The author and his colleagues were dismayed to find how high was the toll of complications in a series of men managed 'conservatively' in this way.

There is another group of men for whom urethroplasty must be offered. Their strictures are unusually difficult, often because the bougie finds its way very easily into the opening of one or more false passages, and once the urethra has developed these, dilatation becomes technically hazardous, whilst at urethroplasty it is easy to take the opportunity to lay open all the false channels and make the new urethra clean and smooth.

As experience with urethroplasty increased, so the

surgeons became more and more bold, and offered the operation to patients more willingly. Nevertheless it has its hazards too (Table 3) and, although a recent survey of the writer's cases showed that 304 of the 445 patients came to urethroplasty, this certainly represents a very biased selection of the case material.

TABLE 3. Complications in 304 urethroplasties

|                            |    | %    |
|----------------------------|----|------|
| Operative death            | 1  | 0.3  |
| Haemorrhage                | 3  | 0.9  |
| Pulmonary embolism         | 1  | 0.3  |
| Wound dehiscence           | 2  | 0.6  |
| Detachment of island patch | 1  | 0.3  |
| Persistent fistula         | 10 | 3.2  |
| Hair-ball stone            | 5  | 1.5  |
| Recurrent stricture        | 19 | 6.2  |
| Carcinoma (squamous)       | 1  | 0.3  |
| Total                      | 43 | 13.7 |

#### Anterior urethra

Only 30 of these 304 urethroplasties were for strictures in the anterior urethra. The technique now preferred is that described by Leadbetter and Leadbetter (1962), Yaxley (1967) and Orandi (1968). Its principles are simple: a patch of scrotal or penile

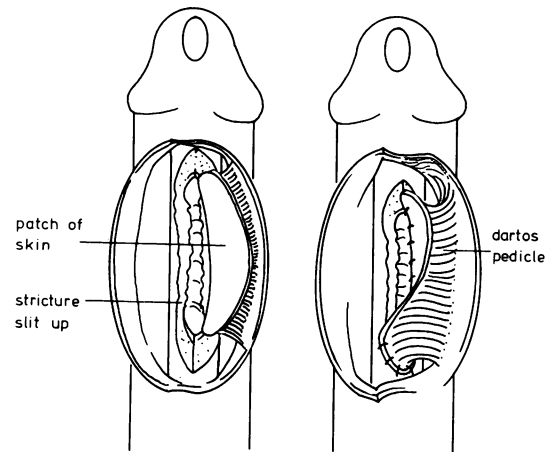


FIG. 18. Dartos-pedicle skin patch one-stage urethroplasty for strictures of the anterior urethra

skin is taken to enlarge the narrowed urethra (Fig. 18). It is provided with its own private blood supply by a pedicle formed from the dartos muscle, which is universally distributed over the penis and scrotum and can be easily separated from the overlying skin. The presence of this distinct and easily defined muscular pedicle means that an island of skin of almost

any size or shape can be prepared which will suit a stricture of almost any length and one which is situated in almost any part of the urethra. The blood supply of these patches is so profuse that they heal despite extravasation or urine haematoma or infection (Gardiner *et al.*, 1978). In 2 of the writer's patients the patches have survived severe tests: in one, a huge haematoma had to be evacuated, but the patch stayed put, the wound healed *secundum artem*, and the stricture healed perfectly. The other developed an erection on the third postoperative night; the catheter became dislodged, the patch came away from the urethra, and infected urine was extravasated. The patch was sewn back into position and the wound protected by a temporary supra-pubic diversion. This case also healed uneventfully thereafter. It is comforting to note that others have had similar good results (Harbison, 1976; Olsson and Krane, 1978).

There are theoretical objections to this pedicled island skin patch. First, it is said that, because the patch of scrotal skin is hair-bearing, one must have trouble from the hairs. Since 1968 the writer has records of 81 such patches: hair-balls have occurred in 4 (5%) and in all cases have been easily removed through an endoscope—sometimes with the assistance of the flexible cystoscopic scissors. No doubt more hair-balls will be seen as time goes by, and if one could rely on the survival of a free full-thickness skin graft taken from the prepuce, or the skin of the penis it might be better. The statistics from the proponents of free skin-grafting are rather unimpressive: Betts, Texter and Crane (1978) had 6 failures in 40 cases followed-up for <8 months; Brannan *et al.* (1976) had 10 bad results by one year in 39 cases; Berger, Sykes and Freedman (1976) had

50% good results by 2 years in 28 cases of free skin grafting; Devine *et al.* (1976) had 7 poor results in 60 cases. Against these, the author's own cases show restenosis in 6 of 81 cases (7.4%) in a follow-up varying from 6 months to 8 years (Blandy, Bonert and Cason, 1979).

There is another, more fundamentalist objection to the use of scrotal skin in the urethra which is harder to answer. Its proponents declare that the urethra 'ought' to be lined by urethra, wherefore it must be wrong to use skin—presupposing a knowledge of Divine Purpose not claimed by this writer. One might equally question the purpose of the gonococcus or the need for a dartos in *Homo sapiens*. This idea has led to a resurrection of the old operation of end-to-end anastomosis once favoured by Marion and his school (cf. Azoury and Freiha, 1976). A dozen patients, referred to St Peter's for urethroplasty after end-to-end anastomosis had failed, have made the writer sceptical of this procedure. Contracture takes place at any anastomosis involving the urinary tract, and a urethral stricture is often much longer, when exposed at operation, than one might suppose on the basis of the pre-operative urethrogram. There is a temptation to resect back until healthy tissue is reached, and some of the post-operative results are spoiled by a marked chordee during erection (Fig. 19).

Since the results of the one-stage island patch, using skin provided with a pedicle of dartos, have been satisfactory in the long run the writer will continue to use it as his technique of choice, until better long-term statistics emerge from those centres now dedicated to Marion's operation.

The one-stage island patch urethroplasty can be adapted to strictures which are multiple, and of

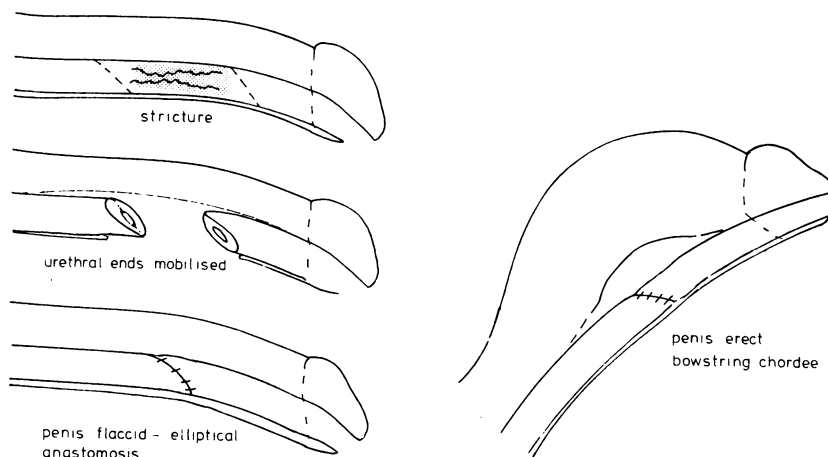


FIG. 19. Excision of the urethral stricture and elliptical end to end anastomosis may result in chordee when the penis is erect.

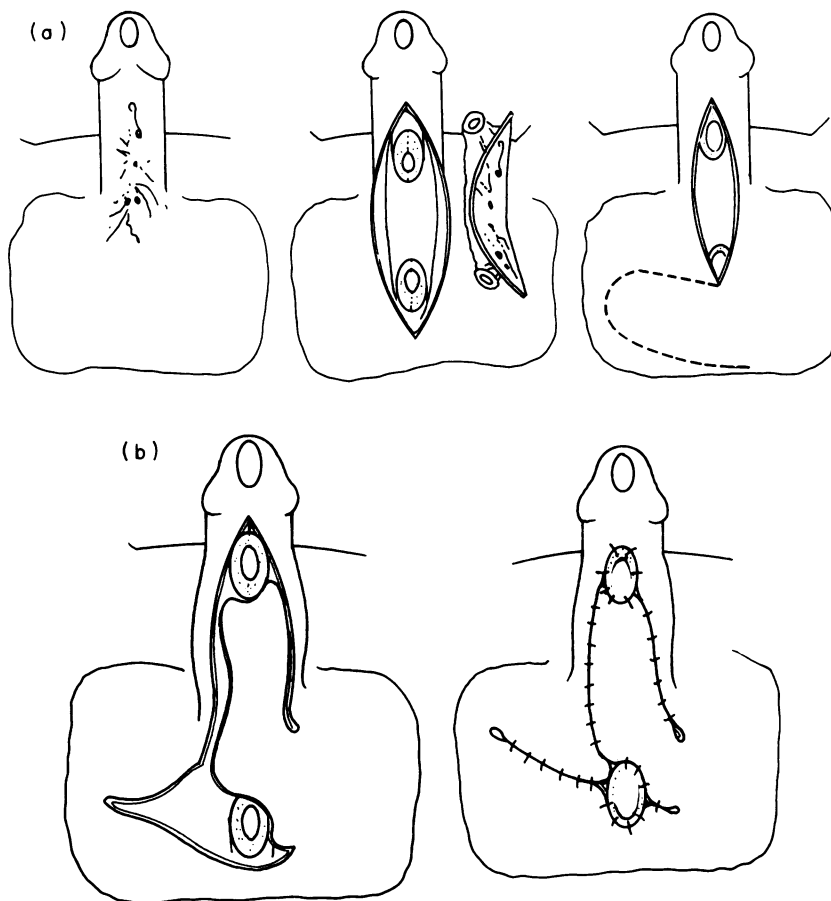


FIG. 20(a) For difficult strictures of the anterior urethra with infection and fistulae, it may be better to excise the diseased urethra at the first stage (b) A flap of scrotal skin is rotated to the penile part of the defect.

almost any length in the urethra, but when there is active infection or the risk of tuberculosis or when there are many false passages, or pockets containing stones, then it is wiser to perform the urethroplasty in 2 stages (Fig. 20). At the first stage all the diseased tissue is either laid open or cut entirely away. When there is a marked chordee, it is better to resect all of the diseased corpus spongiosum. The edges of the defect are then closed with the adjacent scrotal or penile skin. Only several months later is the second stage performed, making a new complete skin tube (Fig. 21) to form the new urethra. The need seldom arises for any form of urethroplasty in the anterior urethra, let alone for an operation done in 2 stages, and it is for strictures involving the bulb and the membranous urethra that urethroplasty really comes into its own.

#### *Strictures in the bulb of the urethra*

Here one can distinguish 2 types: the first is a short tight narrowing, often of congenital origin, but sometimes following trauma. It is not complicated by fistulae, infection or sinuses. The urethra above and below the stricture is relatively healthy. Many of these strictures are easy to dilate, but if they return quickly or if dilatation is followed by infection or pain, then one may need to suggest urethroplasty. Occasionally when there is a short tight ring, a single internal urethrotomy suffices—if not to cure the stricture once and for all—at least to make it possible to keep it under control by infrequent and relatively painless bouginage. Very short strictures in the bulb seem to ask for excision and end-to-end anastomosis, and even today many surgeons use this as their technique of choice, so

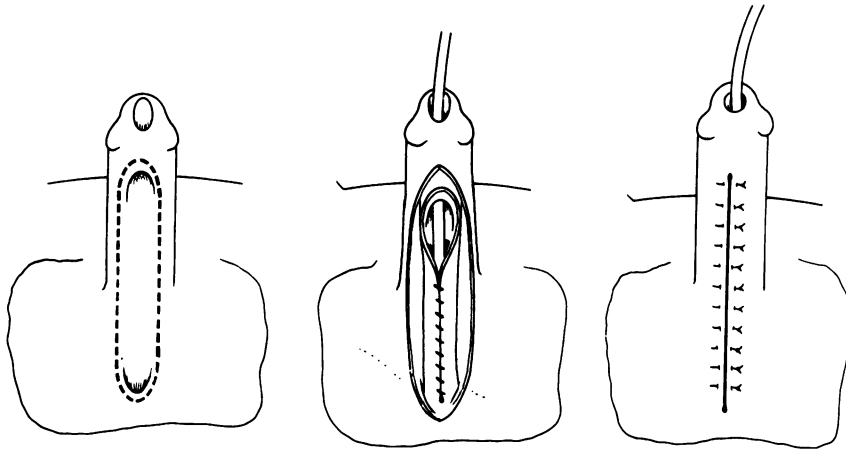


FIG. 21. Difficult anterior strictures—second stage—a full thickness skin tube is formed from the surplus scrotal skin which was rotated up at the previous first stage.

long as the stricture is short and the adjacent urethra healthy.

In these cases the writer's preference is for a Dartos-pedicled pouch, here modified to the deeper situation of the bulbar urethra, by taking the patch of skin from the tip of a broadly based  $\cap$ -shaped scrotal flap (Fig. 22). The author has now used this method in 54 cases, with a satisfactory 7-year follow-up (Gardiner *et al.*, 1978). The island skin patch can be adapted to bulbar strictures of any length, and is especially useful when what seemed to be a short

narrowing in the urethrogram before the operation turns out at exploration to be unexpectedly much longer and the urethral tissue much more indurated and unhealthy.

Many surgeons do not go to the extra trouble to provide the skin with a vascular pedicle of dartos muscle: instead they rely on the use of free grafts of full-thickness skin. The advantage of these free grafts is that they can be taken from the hairless skin of the prepuce and penile shaft. The disadvantage is that—as with Wolff grafts elsewhere in plastic

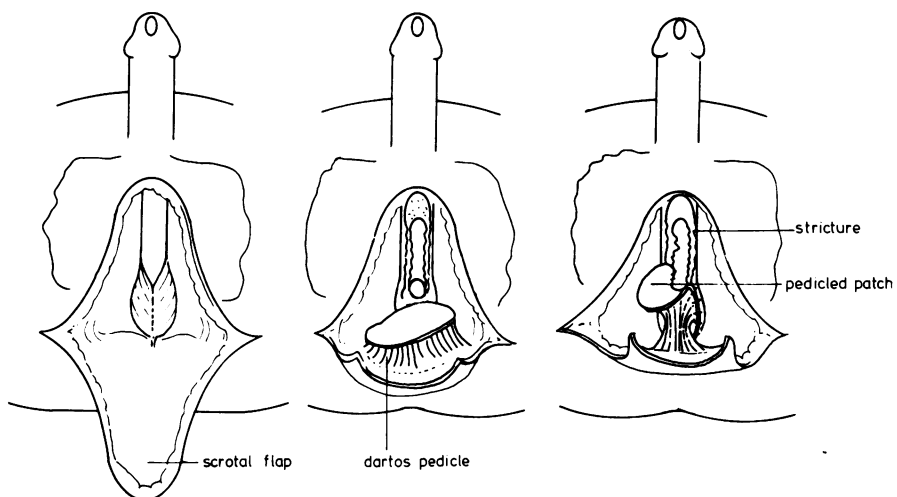


FIG. 22. Dartos-pedicled patch from the tip of a scrotal flap adapted to make a one-stage urethroplasty for the more inaccessible strictures of the posterior urethra.

surgery—they do not always take. Since the drawbacks of using hair-bearing skin are not unacceptable (Gardiner *et al.*, 1978) it seems pointless to run the risk of losing the graft for such a small and doubtful advantage.

It is more difficult to deal with bulbar strictures when they are complicated by fistulae and sinuses. As with the infected and complicated strictures of the anterior urethra, it seems unwise to attempt the operation in a single stage, and a 2-stage scrotal-flap inlay urethroplasty has particular advantages. In former times the writer used this procedure as his method of choice, and many quite easy strictures

were subjected to what we would now regard as an unnecessary 2-stage procedure. Nevertheless, cases still occur in whom local infection and fistulae make it more safe to be sure that the first stage has been done correctly before proceeding to close the new urethra. A 2-stage operation allows one to remove or lay open all the sinuses and abscess cavities in communication with the urethra at the first operation. Having laid it all open (Fig. 23) and having excised any scarred or diseased tissue, until undeniably healthy urethra has been reached, the flap of scrotal skin is laid into the gap. So rich is the blood supply of the scrotum that this flap can be

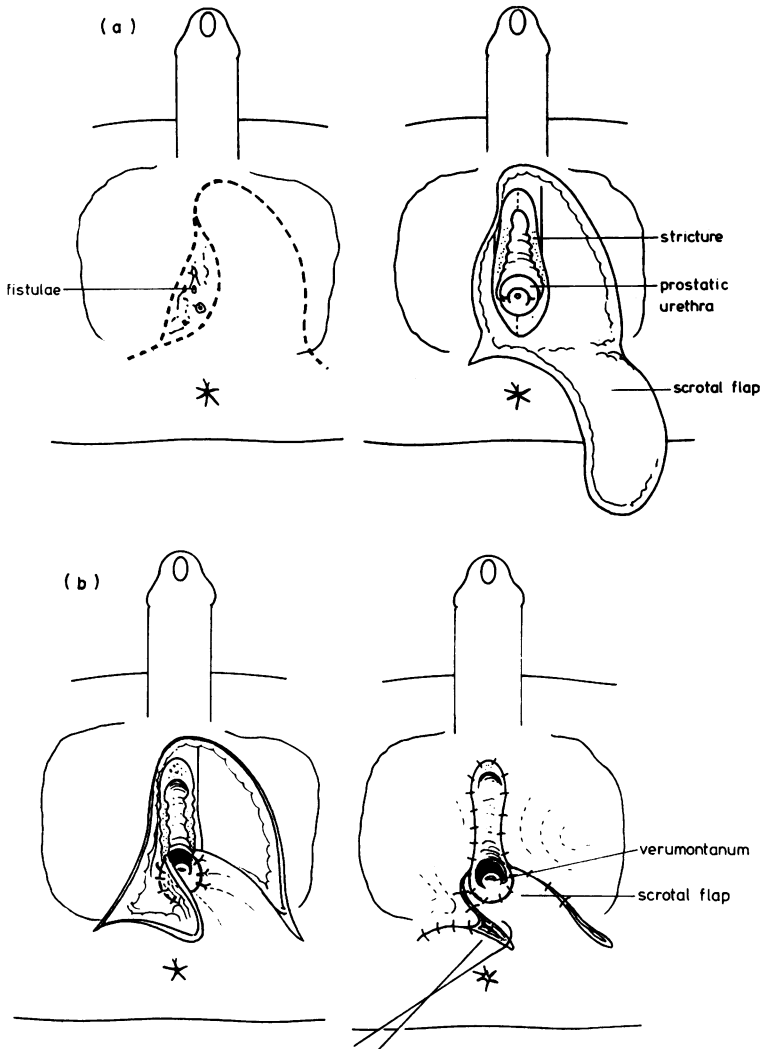


FIG. 23. (a) When there are fistulae and abscesses, the posterior urethra is laid widely open at the first stage and a flap of scrotal skin let into it. (b) The flap of scrotal skin is sutured so as to form a funnel leading up into the prostatic urethra.

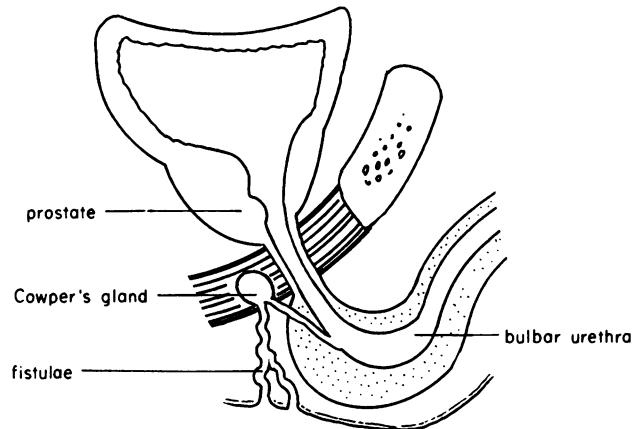


FIG. 24. Sometimes fistulae adjacent to the strictures of the posterior urethra communicate with a persistent undrained abscess in Cowper's gland.

based on one or other side, or in the front if necessary. The slit in the urethra must be carried right up into healthy tissue, even if this means reaching the verumontanum and going across the external sphincter. The tip of the tongue of scrotal skin is sutured into the apex of this slit and forms a long wide cone opening on the perineum.

This wide cone allows regular examination of the suture line during the next few months to make sure that there has been no cross adhesion, and no necrosis of the tip of the flap which would lead to subsequent sloughing and contracture.

One particular variety of this complicated bulbar stricture deserves note. One may find that several perineal fistulae communicate with the lumen of the urethra through a number of openings all leading to a long-standing abscess in one of Cowper's glands,

lying between the layers of the pelvic fascia enclosing the external sphincter muscle. The operation to insert the scrotal skin flap may have to be adapted to lay open such an abscess at the same time (Fig. 24) (Blandy and Singh, 1972).

#### *Strictures of the membranous urethra*

Most of these strictures are caused by fracture of the pelvis in which the prostate is avulsed and displaced backwards, sideways, and upwards. The exceptions are the strictures which follow operations involving a catheter that has caused necrosis at the level of the external sphincter—usually because too large a size of catheter has been used.

Many of these strictures are easily kept under control by regular dilatation, and whenever possible this is the treatment of choice: incontinence may

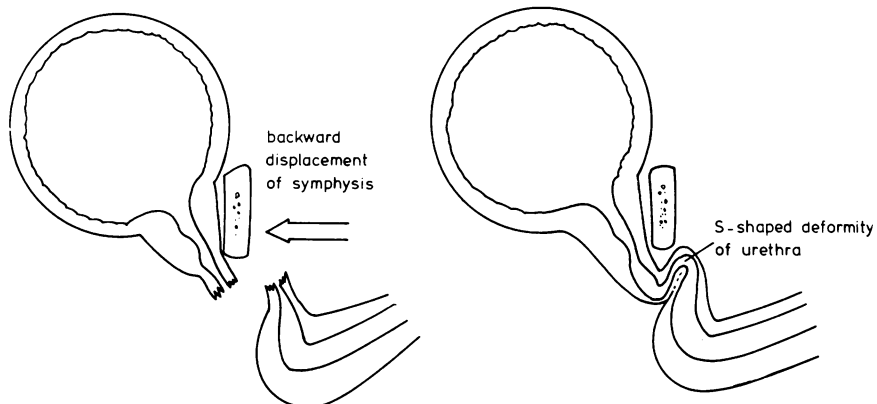


FIG. 25. Ruptured membranous urethra without much displacement of the bony parts may heal with an S-shaped bend, easily divided by the urethrotome.

follow any type of urethroplasty, and even division of the stricture with the endoscopic urethrotome may be hazardous.

In the writer's series, 91 such cases are being satisfactorily dealt with by regular intermittent dilatation. This number should be compared with the 166 who have been subjected to urethroplasty—but the numbers are not comparable, since many of the urethroplasty cases were specifically referred from other hospitals when intermittent dilatation had failed.

Of those in whom regular dilatation is not satisfactory, one can recognize a group in whom the post-traumatic stricture is really not so much a narrowing as an acute S-shaped bend in the urethral lumen, doubled back in such a way that there may be only a narrow membrane separating the lumen of the prostatic from that of the bulbar urethra (Fig. 25). This membrane is sometimes quite thin, and one can cut it through by means of a fine endoscopic electrode or the cold knife urethrotome, provided it is possible to see exactly where to make the incision. If the lumen has been preserved, and this is the main advantage of early surgical repair of these injuries, then a fine catheter can be got past the narrowing, and used to guide the knife. If the lumen has been completely obliterated it is sometimes possible to see the septum separating the 2 lumina, using a cystoscope passed down the suprapubic cystostomy track into the prostatic urethra. A second cystoscope in the urethra may disclose the glow of the light.

Even when the membrane is too thick for such an internal urethrotomy, so long as the length of the stricture is no more than a centimetre or two, one

may be able to bridge the gap with a dartos-pedicle skin patch taken from the tip of a long scrotal flap. Unfortunately, not all of these membranous strictures are so easy to deal with. In some of them the unreduced displacement of the pelvis keeps the bladder and prostate riding high in the pelvis unless an attempt has been made to mobilize them and bring the divided ends of the urethra together (Fig. 26). In such patients, the situation is often made worse by the presence of stones, wires used to attempt the fixation of the unstable pelvic fragments, calcified haematomas, osteomyelitis, or persistent sepsis. In one such patient, 4 screws had to be removed from the hip. They had penetrated the acetabulum and, for a time after their removal, the patient voided through his hip joint. Massive pelvic scarring makes the reconstruction of the urinary tract unusually taxing, because the normal anatomy is obscured. In dealing with these 'difficult' high-riding, unreduced, ruptured membranous urethrae it is not possible to lay down hard-and-fast rules, for each case must be treated on its merits. Clearly the first task is to remove stones and foreign bodies, and drain pockets of pus. Since suprapubic cystostomy alone may not be sufficient to divert the urine from the scene of the pelvic sepsis, one may need to make an ileal conduit as the first preliminary to setting about the long-drawn-out task of reconstruction.

When local infection has been somewhat cleared up, it may be possible to plan how best to bridge the gap. Because the anatomy is so distorted by scarring, the use of an ordinary scrotal flap from below is ruled out by the inability to identify the margins of the prostatic urethra proximally. Borrowing a

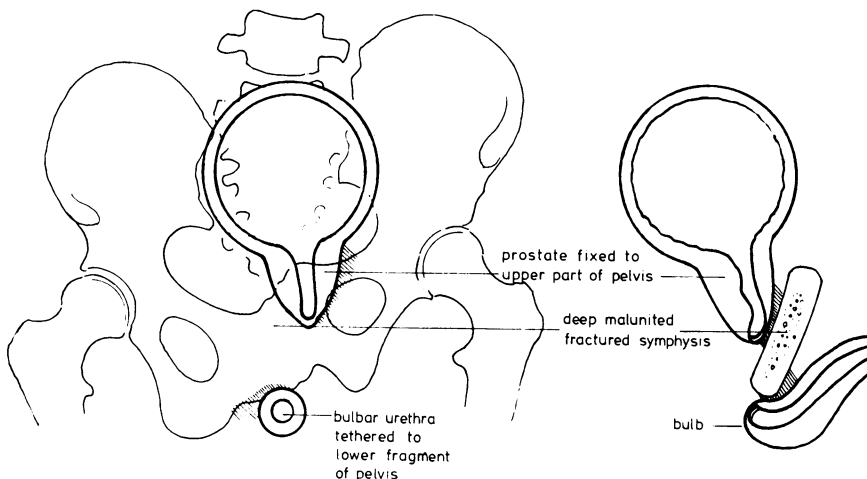


FIG. 26. Ruptured membranous urethra with unreduced displacement of the pelvic fragments: bony deformity keeps the torn ends apart, and the resulting callus makes the symphysis abnormally deep.

technical trick which Innes Williams devised for using the scrotal flap in children, the writer found it in some cases possible to effect union between scrotal skin and proximal urethra by forming the scrotal flap into a long tube, skin on the inside, which was then fixed by a strong suture to a catheter, and so drawn up into the bladder via a suprapubic cystostomy. Raw surface stuck to raw surface and, after 2 or 3 weeks when the stitch was undone and the catheter removed, the way from perineum to bladder neck was found to be lined with healthy scrotal skin.

With increasing experience of such cases the writer has come to give up this rather difficult operation in favour of the more simple approach described by Pierce (1972) and popularized by Waterhouse *et al.* (1974) in which part or all of the symphysis pubis is removed leaving a gap through which the mobilized urethra is drawn and sewn neatly to the front of the prostatic urethra (Fig. 27).

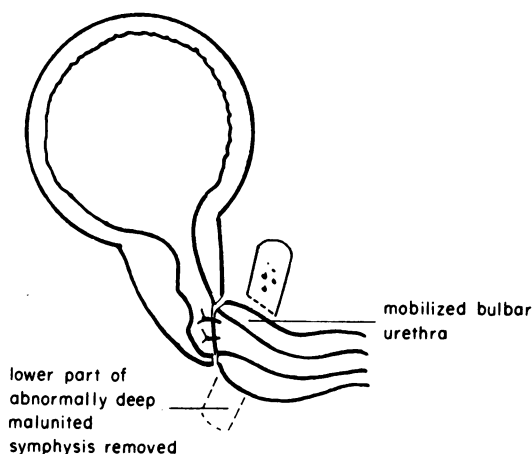


FIG. 27. By removing some of the inferior part of the symphyseal callus the urethra can be brought up and sewn to the lower end of the prostatic urethra.

If this method fails, it is still possible to resort to the tube of scrotal skin. In fact, it is unnecessary to remove a complete segment from the pubic symphysis because the overriding deformity of the fracture in these cases means that the pubis is so deep that all the needed extra room can be obtained by cutting an arch from the inferior edge of the bone, thus exploiting the old sub-pubic approach of Kishev (1964) by carrying it one step further. This modification of the transpubic operation has the great advantage that it leaves no large defect into which the penis will drop—and an ugly deformity is seen if this takes place—and also, there is no danger that pelvic instability will prevent the patient from run-

ning or jumping later on. Disability resulting from the gap in the bony pelvis is a rare complication, but the writer has seen one young patient who could no longer run for a bus in consequence of this, and it should not be ignored as a possible late sequel of transpubic urethroplasty.

#### *Combined injuries involving the rectum*

Among these very difficult 'high' strictures are a small number of men with particularly bizarre and unusual injuries. They are going to increase in number, as more and more efficient rescue and resuscitation prevents these severely injured men from dying from loss of blood. Here the tremendous crushing and rolling injury which fractured the pelvis and tore down the skin of the thighs, has opened the soft tissues to the hazard of faecal contamination, and in 2 of the writer's 11 cases, gas gangrene has added to the destruction wrought by the original trauma. When the immediate battle to save the patient's life has been overcome, the task of reconstruction must begin. There is nearly always a tear in the side of the bladder as well as more or less loss of urethra. There is a fistula between the urinary tract and the rectum. There is gross deformity of the pelvic ring. Each case must be treated on its merits, and for preference, the urologist should work closely with his proctological colleague. The first step must be to divert urine and faeces completely away from the huge wound. Colostomy is an urgent requirement. For urinary diversion, a simple suprapubic cystostomy may not suffice, since the bladder wall is usually torn as well. An ileal conduit may have to be formed as soon as the patient is well enough to undergo such a major operation.

Later, the urethra may be reconstructed, if enough bulbar urethra has been left intact, using the modification of the transpubic operation described above by which an arch is cut away from the inferior border of the symphysis or, more rarely, the gap may be bridged with a tubed graft of scrotal skin (Blandy, 1978). Through the wide exposure provided at this operation the opportunity may be taken to close the gap in the wall of the rectum. It may be necessary to close a large hole in the rectum wall by Parks' technique, in which a sleeve of the sigmoid is brought down past the hole in the rectum, having first stripped out the lining of mucosa as far down as the anal margin. In cases where the fistula is small, a local advancement flap can be used successfully. All these operations are completed before the colostomy is closed, as are any necessary procedures to restore the continuity of the rectal sphincter. In these cases Parks has been able to locate the anal sphincter, despite long standing scarring after injury, dissect its torn margins, overlap them, and restore faecal continence.



Finally, the ileal conduit is sutured to the bladder, or taken down, and the ureters implanted to the bladder directly. Lastly, the colostomy is closed.

The important message in these very rare and very serious injuries is that they are not impossible to repair, provided surgeon and patient are prepared to give a lot of time and care to a many-staged reconstruction. Since so many of the patients affected by these dreadful injuries are young, and their lives so full of promise, it is a mistake to condemn them to urinary diversion when it is not necessary.

#### *Management of strictures in the female*

Johnston (1976) has discussed critically and at length the various criteria by which urethral stenosis was supposedly diagnosed in young girls in whom it was said to be the cause of recurrent infection. Graham *et al.* (1967) found that, when measured, young girls with recurrent infections had wider urethra than those without, and Forbes, Drummond and Nogrady (1969), in a controlled trial of meatotomy versus no treatment in girls, showed no benefit from the surgical intervention in terms of recurrence of infection or the children's symptoms. More recently, Johnston *et al.* (1976) have very clearly described the 'pseudo-obstructive bladder' of enuretic children in whom radiographic evidence of outflow obstruction is not matched by its urodynamic proof, except that the children voluntarily fail to relax their external sphincter. Echoing the advice of Allen and Bright (1978), Johnston *et al.* (1978) point out:

'it is important to realise that these children do not have any infravesical obstruction to micturition and that there is no indication for widening or resecting the bladder neck, or for urethral manoeuvres such as dilatation or urethrotomy, or the fulguration of imaginary urethral valves'.

These sentiments are shared by Zufall (1978) who has catalogued the procedures which have not merely been suggested but actually carried out in hundreds of women in the cause of widening a supposedly narrowed urethra when they have 'lower tract symptoms without definite objective findings'. Zufall cites the published reports of surgeons who have cut or widened the bladder neck by incision or Y-V-plasty, performed hymenoplasty, internal and external urethrotomy, meatotomy, meatal reconstruction, external urethroplasty, vigorous dilatation, unroofing of the urethral glands, and have exhibited a wide range of medicines. In his study he compared the effects of doing nothing, with the passage of sounds of different calibre, from

very small to very large: antibacterials and anticholinergic drugs in combination or singly. Whatever active treatment was chosen, about 60% of the women said they got better. The smallest bougie gave better results than the biggest. Best of all were the results when he did nothing—100% of these women were cured. We surely need a psychiatrist to study the symbolism of the urethral dilator, this might throw light on the question why so many patients and their surgeons are attracted by its use.

This is not to imply that all urethral strictures are imaginary, or the dilator useless. On the contrary, very stiff tight urethral stenoses are often found in women with other evidence of generalized atrophy of the vaginal introitus and, since the cause is at least in part want of oestrogenic stimulation, it is logical to combine suitable oestrogen medication with the urethral dilatation. Since many elderly women find the mechanics of the application of oestrogen creams to the vulva distasteful and difficult, a pill is usually better, given suitable precautions. Careful urethrotomy may be needed to supplement the dilatation.

Postoperative strictures which follow operations on the urethra, e.g. for diverticula, may not respond to dilatation and on rare occasions urethroplasty may be needed. A patch can be taken from the labium minus on one side or the other and provided with a pedicle analogous to that used in the scrotum, and the patch can be sewn into the urethra to enlarge it permanently. Such a skin tube can in fact be used to restore the complete urethra if it is lost, or must be excised.

After trauma, there is usually loss of part of the urethra as well as a stenosis of its upper end. A new tube can be made from vaginal skin without difficulty but this does not imply that continence will be restored, however much care is taken to reinforce the skin tube with adjacent muscle.

It is in the treatment of the large post-partum defects, often combined with urethral stenoses of the remaining upper stump of the urethra, that one must exercise the utmost surgical ingenuity. To experienced operators such as the Hamlins (Hamlin and Nicholson, 1969) no vesico-vaginal fistula is too enormous to daunt them. In Britain, the opportunity to repair these fistulae comes seldom. The author has sought to use remaining bladder wall, in the more severe cases, to bolster up the bladder neck, and has resorted to ileo-caecal replacement to fashion new bladders (Blandy, 1978). With more experience, these procedures may be avoidable if one adapts the Hamlins' use of the gracilis graft as reinforcement for the urethra.

As with reconstruction of the more severely damaged male urethrae, so also for women whose bladders have been left empty, and sometimes almost

everted, with gross vesico-vaginal fistulae, every effort should be made to restore normal anatomy. The bladder has the most remarkable capacity for growing again to the size which is needed, and one should never be put off by the thought that the newly closed bladder will be too small.

### Conclusions

With increasing confidence, and a growing number of well tried operations, there are today few strictures which cannot, if necessary, be offered permanent 'cure' by means of one form of urethral operation

TABLE 4. Methods used in 329 urethroplasties 1964 to 1979 inclusive

|                        | No. | %    |
|------------------------|-----|------|
| Meatoplasty            | 47  | 14.3 |
| Anterior 2-stage ops   | 17  | 5.2  |
| Marion end-end         | 1   | 0.3  |
| Waterhouse type        | 10  | 3.0  |
| 2-stage scrotal inlay  | 150 | 45.6 |
| 1-stage pedicled patch | 104 | 31.6 |
| Total                  | 329 | 100  |

or another (Table 4). Not all of these necessitate the interposition of elaborate flaps of skin; some are very simple, and the simplest of all—regular dilatation—still has an important place in the management of the majority of urethral strictures. However, for the patient who finds dilatation painful or in whom it is difficult and dangerous, and for the more severe strictures in which dilatation has obviously failed to prevent the complications of septicaemia, a false passage, or fistula, then one can today offer new hope. Urinary diversion through a permanent suprapubic cystostomy, ureterocolic anastomosis or an ileal conduit, is hardly ever required, and should be considered only as a last resort.

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