animals. There is a breed predisposition in the UK (Labradors, Golden Retrievers and Skye terriers) whilst in the USA Siberian Huskies, Newfoundlands, Bulldogs, West Highland White terriers, Fox terriers and Miniature and Toy Poodles appear to be at risk.

The cause is unknown but hereditary factors may play a role. Incontinence may be continuous (Fig. 4, page 11) or intermittent and even when both ureters are ectopic (bilateral ectopic ureter), the dog can usually still pass a normal stream of urine, despite the copious leakage at other times. Diagnosis is by contrast radiography (special x-ray studies discussed in more detail in the section How is urinary incontinence investigated?). Secondary complications are common and usually involve the kidney and ureter on the affected side. For example, the area of the kidney where urine collects before passing down the ureter may become dilated (distended) with urine (hydronephrosis) or infected (pyelonephritis) and the ectopic ureter, itself is usually dilated with urine (hydro-ureter).

**Congenital Urethral Sphincter Mechanism Incompetence**

Congenital urethral sphincter mechanism incompetence means that the dog is born with a weakness of the urethral sphincter mechanism. This is the second most common cause of juvenile incontinence (35% of incontinent juvenile dogs) and tends to be a problem of large breeds of dog, predominantly bitches. Leakage of urine is more copious compared to animals with ectopic ureters, and occurs predominantly when the dogs are lying down and relaxed or asleep. The urethra may be abnormally short (urethral hypoplasia) or even absent. Urethral diverticula (cavities outpouching from the urethra) and urethral dilatations may be present in male animals.

In many bitches, no gross abnormalities are detected on contrast radiography, apart from a bladder which is located too far back (‘caudally positioned bladder’) and the diagnosis frequently relies on the history and elimination of other possible causes of incontinence. Urodynamic investigations (such as a technique called urethral pressure profilometry) can be used to measure the resistance in the urethra and are of some value but are not always diagnostic and are rarely available in most veterinary practices.

**Bladder Hypoplasia**

Bladder hypoplasia basically means that the dog has been born with a bladder which is too small for the size of the animal. This is a subjective diagnosis and it is unclear if the problem is true bladder hypoplasia or failure of normal bladder growth and development. It is commonly associated with other congenital (present from birth) causes of incontinence but may, rarely, occur alone. The diagnosis is confirmed by contrast radiography as only a small amount of contrast medium is required to fill the bladder during retrograde techniques (see later). It is important in animals with a presumptive diagnosis of bladder hypoplasia to eliminate other causes of incontinence which may also be present. For example, the small bladder may be a reflection of poor bladder development because of lack of stimulation by adequate volumes of urine in the bladder (e.g. the dog with ectopic ureter, in which much of the urine bypasses the bladder and so is not stored).
Pervious Urachus

Pervious urachus is seen when a communication (the urachus), which is present in the foetus, between the bladder and the umbilicus (navel) fails to close before birth. This means that the leakage of urine occurs through the umbilicus, leading to scalding of the skin on the lower abdomen in that region (Fig. 5). It is very rare in puppies compared to horses and farm animals. This condition is easily diagnosed since incontinence occurs through the umbilicus which may be scalded with urine. Contrast radiography confirms the diagnosis (see later).

Intersexuality

Intersexuality occurs when animals are born with both male and female genitalia. Rarely, intersex animals may be incontinent. During urination, some of the urine passes normally down the urethra while some urine accumulates in abnormally-present internal sex organs (for example within a vagina inside a dog which externally looks male! – Fig. 6). The urine which accumulates in the vagina subsequently leaks out via the urethra between urinations, thus leading to the sign of incontinence. Diagnosis relies on contrast radiography such as retrograde positive contrast urethrocystography (contrast imaging of the urethra and bladder).

Congenital Neurological Conditions

Very rarely, puppies are born with abnormalities of the spine. The main sign in these animals is an inability to stand and/or walk normally but incontinence (urinary and faecal) may also be present. Spinal radiography and or MRI scanning may confirm the diagnosis.
What are the causes of urinary incontinence in adult animals?

Most causes of urinary incontinence in dogs are acquired; that is, they develop in adulthood in a dog which was previously continent. Incontinence in adults is much more common in bitches than in male dogs. Although there are many conditions which can lead to urinary incontinence in adults, by far the commonest (80% of incontinent adult bitches) is acquired urethral sphincter mechanism incompetence. More details will be given about this condition than the other, much rarer, causes of incontinence therefore. The main causes of adult incontinence are:

- Acquired urethral sphincter mechanism incompetence
- Prostatic diseases
- Bladder neoplasia (cancer)
- Ureterovaginal fistula
- Acquired neurological conditions
- ‘Overflow’ incontinence
- Detrusor overactivity/instability

Acquired Urethral Sphincter Mechanism Incompetence

In adult dogs referred for the investigation of urinary incontinence, urethral sphincter mechanism incompetence – failure of the urethral sphincter mechanism – is by far the commonest diagnosis made, affecting 80% of incontinent bitches. In these animals, incontinence occurs mainly when the dogs are recumbent and relaxed (Fig. 7). Although this is the doggy equivalent of human stress incontinence, few of these animals leak doing aerobics! Thus most owners notice that there are damp patches or pools of urine on the floor, carpets etc. where the dog has been lying. Although urethral pressure profilometry – measurement of the tone of the urethral wall – can be used to demonstrate incompetence of the urethral sphincter mechanism, this technique is not readily available in general practice and is predisposed to a number of artefacts which can make interpretation difficult. In general practice, therefore, the diagnosis is usually made on the basis of the breed, history and by the elimination of other possible diagnoses using imaging (radiography) and laboratory techniques. Acquired urethral sphincter mechanism incompetence usually (but not always) follows neutering in both bitches and male dogs. Before treatment can be contemplated, an understanding of the pathophysiology (i.e. the factors which contribute to the condition) of urethral sphincter mechanism incompetence is
required. Our current knowledge is more extensive in the bitch (the commonest sex affected) and so what follows relates to female dogs although mention will be made of males later. Since no true bladder neck sphincter muscle exists in the bitch and continence is maintained by a complex mechanism of interacting factors, the term ‘urethral sphincter mechanism incompetence’ has been used to describe a weakness of urinary continence control.

The ‘urethral sphincter mechanism’ is a term used to summarise the forces acting in the urethra to keep the urethra closed and prevent incontinence. A number of factors are believed to contribute towards this sphincter mechanism and these include:

- Urethral tone – the ability of the tissues of the urethral wall to prevent the passage of urine when an animal is not urinating. Measurement of urethral tone (urethral pressure profilometry) has demonstrated that poor urethral tone is implicated in urinary incontinence. Urethral tone is maintained by a complex interaction of neuromuscular, vascular and passive elastic components and it is unclear which of these is deficient in sphincter mechanism incompetence.

- Length of the urethra – there is considerable variation in urethral length between bitches of different sizes. However, taking body size into consideration, bitches with sphincter mechanism incompetence tend to have shorter urethras than continent animals.

- Position of the bladder neck – a number of authors recorded the radiographic finding of a caudally positioned bladder (also referred to as a ‘pelvic bladder’) during the investigation of incontinent animals (compare Fig. 12c with Fig. 12a on page 22). The significance of this finding was disputed in the past but there is now good evidence that an intrapelvic bladder neck (i.e. a bladder the neck of which is too far back, inside the pelvic cavity – a so-called ‘pelvic bladder’) contributes significantly to urinary incontinence due to urethral sphincter mechanism incompetence. The caudal bladder position in affected dogs is associated with the shorter urethral length and also the fact that the bladder moves backwards when a bitch moves from a standing to a relaxed recumbent position. This movement is more pronounced in bitches with urethral sphincter mechanism incompetence than in continent animals, suggesting a deficiency in supporting mechanisms in the lower urinary tract of affected animals.

- Breed and body size – body size appears to be a factor since large and giant breeds are particularly at risk. Urethral sphincter mechanism incompetence is most common in the UK in Dobermans and Old English Sheepdogs, and there is evidence that these breeds and Rottweilers, Weimaraners, Springer Spaniels and Irish Setters are at increased risk for developing this form of incontinence.

- Obesity – whilst not a cause of the condition, obesity may worsen the degree of incontinence.