CHAPTER 3

Handling and Restraint

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Introduction

The laboratory rat, like its wild counterpart, is an extremely intelligent animal, probably more so than the other rodents commonly used for biomedical research. This is reflected in its behaviour and, when treated properly and sympathetically, its tolerance to handling and restraint. Although feared by many novice animal scientists and technicians, outbred rats of either sex are usually docile and tractable, particularly if handled regularly and from early in their life. Some inbred strains, however, can be a little more fractious than their outbred cousins and these will need to be treated with more respect. The rat does not suffer fools gladly and if handled incompetently and with a lack of confidence or not afforded due respect will express its feelings quickly, decisively and in a way the handler is unlikely to misinterpret or forget!

It is imperative that all animals, irrespective of species, are handled and restrained in the correct manner, first and foremost to prevent any possibility of injury to those animals. Our primary concern when performing any form of manipulation must be for the health and welfare of the animal. A good handling or restraining technique will not only eliminate the risk of physical injury to the animal but will also reduce the level of stress caused by the manipulation. Although the welfare of the animal must be paramount we must also consider the safety of the individual carrying out the procedure in order to minimize the risk of injury through bites or scratches. Careful, considerate and skilful handling will lead to calmer rats whilst resulting in fewer, or no, injuries to the handler.

Safety

Although the risk of bites appears uppermost in the minds of many people working with laboratory rats, the incidence should be low and the damage caused extremely small. Rats will not usually make an unprovoked attack on the handler. Something he or she did incorrectly will have triggered the attack and an investigation into the cause will clearly implicate

the person performing the handling. The handling/restraining technique of any member of staff bitten on a frequent basis should be reviewed by a more experienced colleague. Undoubtedly this investigation will highlight poor or incorrect technique or, perhaps, a lack of confidence, at which time the appropriate action must be taken. This may involve retraining or an attempt made to build or restore the confidence of the handler, perhaps by using younger animals, for example those that are newly weaned.

Some workers are known to favour the wearing of 'antibite' gloves when handling or restraining laboratory rats. They are usually worn because of a lack of confidence in the handler accompanied by a lack of experience or inadequate training. In my experience there are no gloves commercially available which offer protection from a rat bite whilst still providing the necessary sensitivity of touch that will allow the animal to be restrained correctly. Whilst offering adequate protection to the handler this lack of sensitivity could pose a risk of injury to the animal either through crushing or being dropped on to the floor of the animal room. Their use should not be encouraged and this type of personal protection should not be seen as a substitute for correct handling, particularly as the animal's health and welfare could be put at stake.

The greatest risk to human health through working with laboratory rodents, and rats in particular, is the development of an allergy to them. At some establishments the incidence of animal allergy in staff working with animals has been reported to be as high as 37% (Davies *et al.*, 1983). This may be manifested initially as a mild rhinitis, conjunctivitis, tightness of the chest or the development of rashes or weals on the skin. In some individuals the respiratory symptoms may lead to asthmatic attacks. In many instances the reaction of individuals to the allergens can become so severe that redeployment of the affected individual to non-animal work may be the only option (Davies and McArdle, 1981). Rare cases of anaphylactic shock as a result of a rat bite have been reported (Teasdale *et al.*, 1983). Contracting an allergy is not just restricted to those new to animal work. Although a significant proportion of staff become sensitized within their first year of contact there are recorded cases of animal workers with up to 20 years' exposure to a particular species developing an allergy (Lutsky and Neuman, 1975).

The main source of allergens appears to be from the urine of prepubescent male rats but the prepubescent female is also implicated to a lesser extent (Longbottom, 1984). In the warm conditions to be found within an animal unit the urine-soaked bedding dries and then, due to the activity of both humans and animals, the allergen becomes airborne. Whilst working in animal rooms containing rats, care must be taken to minimize the generation of airborne particles. Staff must be provided with high-quality respiratory protection. Those who refuse to wear this protection, wear it incorrectly or use a design which offers insufficient protection, are particularly vulnerable to laboratory animal allergens.

To greatly reduce the risk of developing an allergy to rats there are a few simple rules to observe when working in the animal facility. It is important to wear good protective clothing – gown or boilersuit, hat and gloves – and adequate respiratory protection at all times. Masks should be changed regularly as their efficiency becomes impaired and damaged gloves should be replaced immediately with a new pair. Reusable respiratory protection should be cleaned and stored correctly. Care must be taken with the storage of used protective clothing, possibly contaminated with dust or urine, to eliminate contact with outdoor clothing. Hands must always be washed when leaving the animal area. The housing of rats in filter-top boxes, isolators and ventilated or laminar flow racks are effective ways of reducing the level of allergen in the working environment.

Wild rats act as a reservoir for several zoonotic agents. Whilst there are reported cases of laboratory and animal technicians contracting disease from laboratory rats these are relatively rare and most of them occurred several years ago before the introduction of the high-quality disease-free animals which are widely available for use today.

Handling and Restraint of the Rat

A definition of both handling and restraint will serve to eliminate any confusion over these two terms in the text that follows. Handling is seen as the manipulation of an animal by hand for the purposes of removing it from the cage and transferring it to another cage, onto the pan of a balance for weighing or onto another surface such as a benchtop for

restraint purposes. Restraint is defined as the immobilization of a conscious animal by keeping it, or part of its body, in a fixed position for a significant period of time while an examination or procedure is carried out (Biological Council, 1992). It may also be necessary to partially restrain an animal to prevent interference and/or damage to an operative site following surgery if, for example, blood vessels or ducts have been cannulated. This will be discussed briefly towards the end of this chapter but if restraint for this purpose is contemplated reference should be made to Chapter 27 or the publication by Waynforth and Flecknell (1992) in which this topic is covered in much greater detail.

It is possible for a researcher to carry out many different types of procedure on the rat with one hand whilst restraining the animal in the other. Some procedures, however, will require the cooperation of two people, one providing the restraint whilst the other performs the technique. Longer term restraint will require the use of a specialized restraining device. This latter type of restraint may also be used if an assistant is not available or to reduce a two-person task into one which may be performed alone.

Successful hand restraint employs sufficient firmness to prevent movement and possible injury to the rat whilst a procedure is performed. Some procedures, for example injections, may cause some momentary pain or discomfort, resulting in the rat attempting to take avoidance action. It is important that the degree of restraint is such that it is capable of counteracting this movement but is not so firm as to risk physical injury to the animal.

Any form of restraint can be stressful to the animal, with the degree of stress often increasing over time. Its duration, therefore, should be kept to an absolute minimum. It has been shown that even the briefest handling procedure, lasting for as little as 30 seconds, can act as a stressor as measured by a rise in the plasma glucocorticoid levels (Kvetansky *et al.*, 1978). Barclay *et al.* (1988) found that restraint produced significant values of their 'Disturbance Index' and that this increased with the duration of restraint.

The degree of stress can, however, be reduced. Kant *et al.* (1985) concluded that rats subjected to repeated restraint become habituated to the procedure which was then no longer perceived as stressful. Familiarization of animals to the techniques to which they are later to be exposed should, therefore, be seen as an important part of the acclimatization period leading up to the actual experimental work.

Training – the Individual and the Animal

Perhaps the most common problem leading to a high risk of accidental injury to the rat is incorrect and inadequate restraint. This is usually a lack of firmness, allowing the animal too much freedom of movement. In this situation there is a realization on the part of the rat that escape is a distinct possibility and on the handler that his or her fingers are in danger of being bitten! At such times it is not unknown for an individual to panic, dropping the animal rather than carefully replacing it back in the cage and trying a second time.

Before performing any type of handling or hand restraining technique on the rat it is essential that the individual who is to perform the procedure is both properly trained and aware of the effect his or her actions will have on the animal. Although it may be possible to follow the instructions in the following text, this should not be viewed as a substitute for proper and thorough training by a more experienced member of staff. This training should be carefully structured, ample time allowed and, of course, be followed by some form of assessment. Initially, compliant animals that are fully familiar with the technique in which training is to be given should be used. Once the trainee has mastered the technique using these animals, he or she may then be allowed to progress to more naïve animals.

Following delivery to the animal facility all animals should undergo a period of acclimatization. This should last for approximately 7 days but may be reduced to 3 days depending on the type of procedure that is to be performed. During this time the animals should be handled regularly and fully familiarized with the methods of restraint to be used later. Rats respond to considerate and skilful handling and time and effort spent here will pay dividends during the course of the experiment in the form of more relaxed animals and in some cases better and more reproducible experimental results. When handled initially there will undoubtedly be some apprehension and tension within the animal coupled with a strong urge to escape. If this is the case the rat should be held around its upper body and gently shaken. This will have a temporary calming effect on the animal, which then can be restrained using one of the methods described later. This and a compassionate and skilful approach to handling will help to overcome any fear or resistance. Barclay *et al.* (1988)

Figure 3.1 The typical 'relaxed rat' position.

showed that handling by an experienced person could lead to a reduction of activity in rats and later confirmed these findings by demonstrating that the behaviour of rats was significantly disturbed when animals were restrained by an inexperienced handler.

Rats, like many other animals, do appear to recognize individuals and will act accordingly when handled by unfamiliar staff. The acclimatization period is, therefore, an important part of experimental work, allowing time for animals to adjust to their new environment, the staff who will be working with them and the handling/restraining techniques which they will experience. It is important to overcome the rats' initial fear or trepidation to handling or restraint by taking the time and trouble to relax them. The typical 'relaxed rat' position is easily recognizable as the animal tucks up both rear legs and extends one, or both, front legs down its side (Figure 3.1). To reach this relaxed state the animal should be handled in the manner described below. The rat is gripped gently but firmly by placing the hand over its back and with the thumb and second finger placed over the shoulders. The index finger is placed on the head and the three digits then closed together, dragging a fold of skin with them. After performing this simple relaxing technique the animal will prove to be more compliant and much easier to handle. The effects on the rat's behaviour are long lasting and will be obvious for several days even if no additional handling is given in that time. An alternative, but slightly less effective, way is to lift the animal by the loose skin extending from the neck along its back. This technique will be described later.

Anticipating the Animal's Behaviour

Before attempting to handle or restrain a rat it is prudent to make a quick assessment of its likely response to what may be either a novel experience or one which may be resented. In certain circumstances rats may be more difficult to handle and this can lead to an increased risk of injury to either the handler or the animal. Some of these are described below.

- Animals that have just arrived in the animal facility should be treated with greater care. Stress incurred during the transportation, by their new surroundings and by changes in personnel will undoubtedly affect behaviour. It is also unlikely the newly delivered animals will be familiar with the types of restraining and handling methods used in the new facility. There will undoubtedly be some apprehension on their part and a reluctance to be caught and restrained. It is at this time that more patience and consideration is required on the part of the handler. Once settled into their new environment time must be spent on the familiarization process described above.
- Many nursing females will show little or no reaction to the removal or handling of their young but some may perceive a threat to their offspring and take appropriate defensive action to counter that threat.
- An animal which is sick or injured is often more likely to take exception to handling and restraint.
- A rat exposed to a repeated traumatic experience, no matter how mild, will quickly associate removal from the cage or the method of restraint with the unpleasant procedure and take appropriate evasive action.
- Rats are gregarious animals and react strongly to isolation over prolonged periods. They can become destructive in the absence of environmental stimuli and often aggressive towards the handler or to new cage mates if regrouped. If there is a sound scientific requirement to single house a rat it is advisable to provide some form of environmental enrichment or, failing that, to ensure the animals are handled frequently. Failure to observe these simple measures will inevitably be to the detriment of the handler. In cases where rats are to be segregated, for example following surgery, where there is a need to protect a wound or an indwelling catheter, consideration should be given

to single housing the animal for several days prior to the surgical procedure. This will avoid the 'double stress', on regaining consciousness, of postoperative recovery coupled with isolation. During the preoperative period the rat can be provided with some form of environmental enrichment to ease the stress of segregation, but if this is not possible the animal should receive additional sympathetic handling. These minor precautions will not only be to the benefit of the animal but help to ensure that it remains docile and easy to handle.

Approach to the Rat

The approach to handling rats is no different to that used for most laboratory animals. Confidence, or at least an outward show of it, is a key factor. Hesitation on the part of the handler is likely to alarm the animal(s). On the other hand, the approach should not be rushed as this may well frighten the rats, making them more difficult to handle or, possibly, aggressive. Ensure the animals are aware of the handler's presence by confidently placing the gloved hand into the cage and allowing the rats to become used to it. (Although this approach will work with the majority of animals, remember to assess the situation and anticipate what their likely behaviour will be.) An attempt can then be made to capture an animal prior to its removal from the cage.

It is permissible to use the tail to lift a rat from the cage providing it is gripped at its base (Figure 3.2). Handling the rat by the base of its tail is only useful for moving the animal from one location to another close by or for a cursory inspection of the animal's condition. Transferring the rat from cage to cage by this method or from the cage to an adjacent balance pan for weighing is quick and the animal will suffer no harmful effects. If, however, the rat is to be suspended in this manner for more than 2 or 3 seconds, the weight of its body must be supported by using the other hand, the arm or by placing the animal on a flat surface. On no account must an animal be pulled by its tail if, for example, it is using its front feet to grip onto the cage, nor must a rat be swung by its tail as has been described in some publications when discussing euthanasia by concussion of the brain. This is because the force exerted on the tail can result in the overlying skin becoming detached from the body (thought to be a defence mechanism). If the rat holds on to the cage its grip should be carefully broken using the other hand before an attempt is made to lift it. When euthanasing a rat by concussion the animal should be held on its back by gripping around the pelvis with one hand, with the other hand supporting the weight of the animal and controlling its upper body.

Neonates should on no account be held by the tail as this can lead to injury. Young of up to 5 or 6 days of age may be carefully scooped out of the nest and supported in the cupped palm of the hand (Figure 3.3). In this position they can easily be examined or their sex determined. Alternatively, they may be picked up from the cage and held gently between the thumb and first two fingers (Figure 3.4). This method of restraint can be used as the young grow older and become more mobile

Figure 3.2 Removing a rat from the cage by the base of its tail.

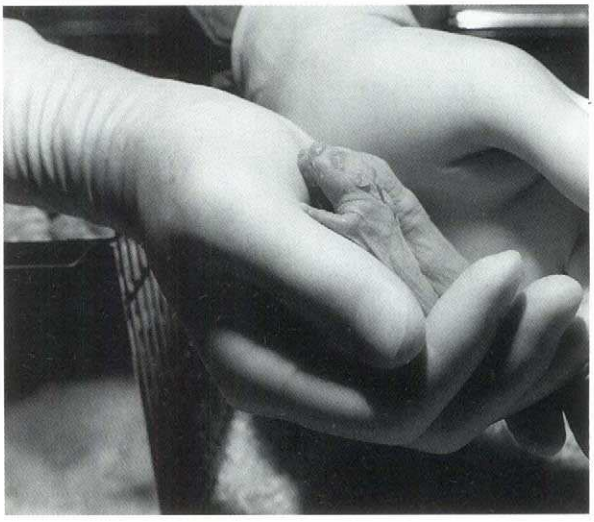

Figure 3.3 Holding neonates in the cupped hand.

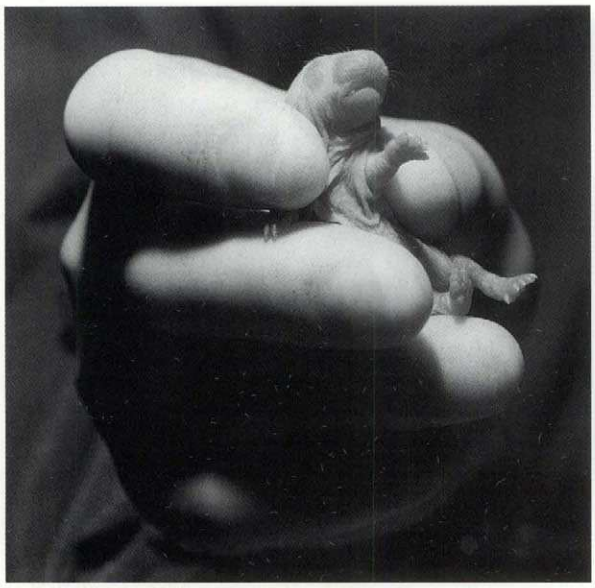

Figure 3.4 Restraining a neonate between thumb and fingers.

but it may require the use of all the fingers to prevent them from escaping (Figure 3.5). Once the young reach 2 weeks of age the method of handling described in the next paragraphs for adult animals can be employed, although at this age the risks of bites are low and the head control, therefore, less critical. It is permissible to lift young rats of this age by the base of the tail as described previously. The sex of newly weaned animals can easily be determined by holding the base of the tail and lifting the animal's rear legs off the floor of the cage to expose the genitalia (Figure 3.6).

Figure 3.5 Restraint of preweaner.

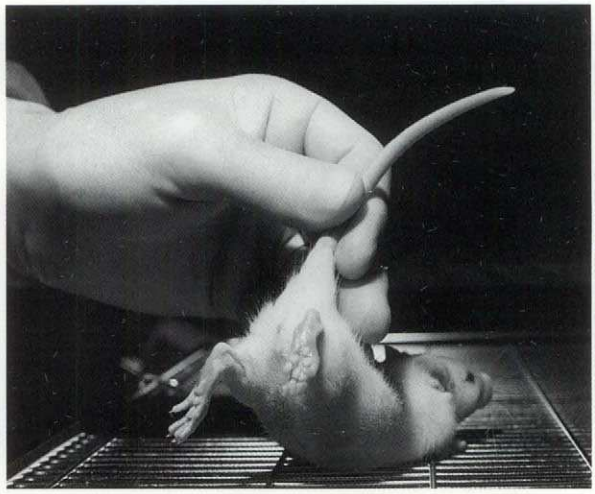

Figure 3.6 Using the tail method of restraint to sex a rat.

Methods of Restraint by Hand

For more detailed inspection purposes or to perform a procedure on the animal, some form of restraint will be required in order to immobilize the animal or part of it. Some procedures, for example injections, can be performed by a single individual – restraining the rat with one hand whilst the other is used to manipulate the hypodermic needle and syringe; other procedures may require the assistance of a colleague to hold the rat. Alternatively, it may be possible to use a restraining device which will in effect mean the procedure can be carried out by a single member of staff. The use of restraining devices will be discussed later in this chapter.

Both young and adult rats can be lifted from the cage by placing one's hand over the back of the rat and sliding the thumb underneath the animal and between its front legs until it rests on the lower side of the jaw (Figure 3.7). It is the thumb which will give the important control of the animal's head, restricting movement and preventing any possibility of a bite. Care must be taken to apply only sufficient pressure with the thumb to control head movement without impairing the animal's ability to breathe (Figure 3.8). Alternatively, control of the head may be achieved by again placing the hand over the back of the rat as described previously but on this occasion using the thumb and fingers to apply gentle pressure in order to cross the front legs, again providing that important restriction of head movement (Figure 3.9). Once lifted from its cage, additional support may be provided by taking the weight of the rat's lower body in the other hand.

These methods of restraint are suitable for holding an animal whilst performing a minor procedure.

Figure 3.7 Grasping a rat around its body to remove it from the cage.

This would include, for example, a thorough health examination or a simple technique such as the application of a substance to the eyes of the animal. If the animal is to be restrained for a more involved procedure the following method should be used.

The rat has an ample supply of loose skin extending from the rear of the neck along the back. This provides an excellent and painless point to grip and restrain the animal. The rat is captured by gripping the base of the tail and the other hand placed over the back of the animal with the thumb and forefinger positioned over the neck and close to its ears. The closeness of the grip to the ears is important as this will prevent excessive head movement. The hand is pressed down gently and the loose skin from the left and right dorsal surface is pulled into the palm of the hand by using the whole of the thumb on one side and the remaining fingers on the other. A tent of skin, extending from the neck region to as far down the animal's back as hand size will allow, is trapped in the palm of the hand, effectively immobilizing the animal. This method of restraint can be used to remove an animal directly from the cage, providing it has a solid floor with some sort of bedding material to act as a cushion or, alternatively, the rat should be removed from the cage by the tail and repositioned on the front of the handler's body and restrained from this point (Figure 3.10). Once a rat becomes accustomed to this method of restraint it will usually assume the 'relaxed rat' position with hind legs tucked up and one or both front legs extended down the side of the body. Not only can this method of restraint be used for a detailed examination of the animal but it is also used for immobilizing animals for the single-handed administration of a substance by several routes.

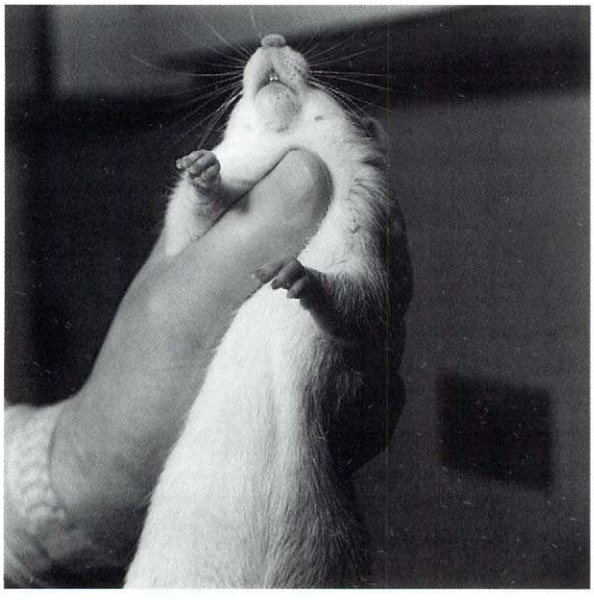

Figure 3.8 Head control using the thumb.

Figure 3.9 Head control by crossing the front legs.

Before attempting any procedure, and in particular those involving hypodermic needles or metal cannula for oral dosing, it is vital to ensure the rat is properly and comfortably restrained, i.e. comfortable for both the rat and the handler. Given the opportunity, an animal will attempt to escape during

Figure 3.10 The rat is positioned on the body of the handler whilst a restraining grip is taken.

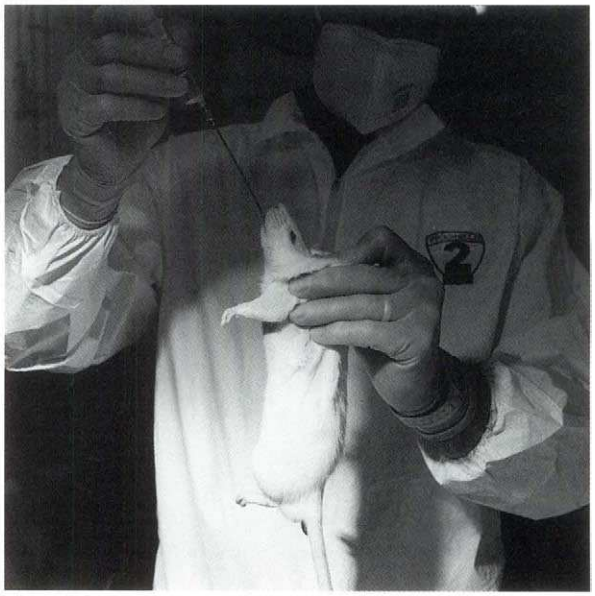

Figure 3.12 Oral dosing using a metal cannula. Note the use of the index finger to pull back the animal's head.

a procedure it perceives as unpleasant. This may result in injury to the animal, a misplaced injection or, occasionally, injury to the person dosing the animal, e.g. needle puncture.

Oral administration

Providing the loose skin is gripped directly behind the ears this method offers sufficient control of the animal's head to allow the introduction of a flexible plastic or rubber catheter (Figure 3.11). If a ball-ended metal cannula is to be used, immobilization of the head and upper body is necessary if injury is to be avoided. Whilst this method of restraint should be sufficient to prevent movement, the position of the rat's head will necessitate the use of a curved cannula to allow easy passage down the oesophagus. If, however, the rat is restrained in the manner described previously for relaxing the animal (Figure 3.12) it will enable the head to be pulled gently backwards, presenting a straight passage from the mouth to the cardiac sphincter. This will allow the insertion of a straight metal ball-ended cannula into the mouth and unrestricted passage into the oesophagus.

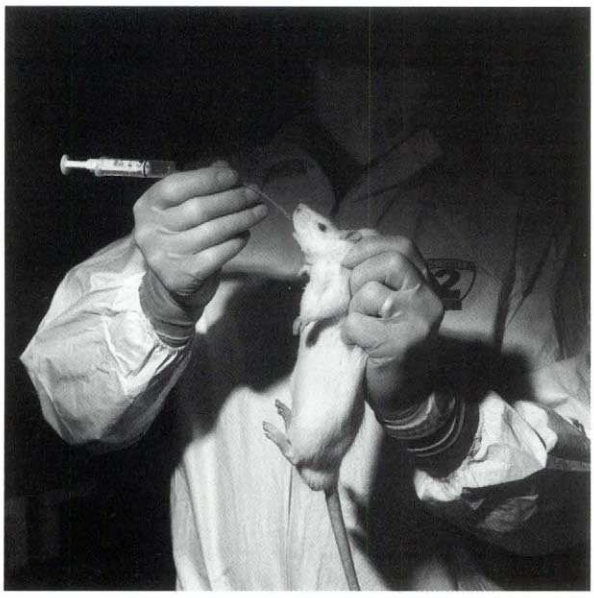

Figure 3.11 Oral dosing using a flexible plastic catheter.

Intraperitoneal administration

The rat is held ventral side uppermost with the head slightly lower than the body, allowing the viscera to fall slightly forward towards the diaphragm and reducing the risk of the needle puncturing the caecum or intestines (Figure 3.13). It is good practice when giving an intraperitoneal injection to insert the needle subcutaneously into the abdomen at an angle of 20–30° and then lift the syringe to 45°, pushing gently through the muscle layer and into the peritoneal cavity. Employing this technique will greatly reduce the number of misdirected injections. Although it is acceptable to perform this technique single-handedly for young animals, the degree of restraint achieved may not be sufficient for older and larger rats. It is advisable with these animals to use an assistant to restrain the animal, thus eliminating the risk of accidental injury to the rat and/or a misplaced injection.

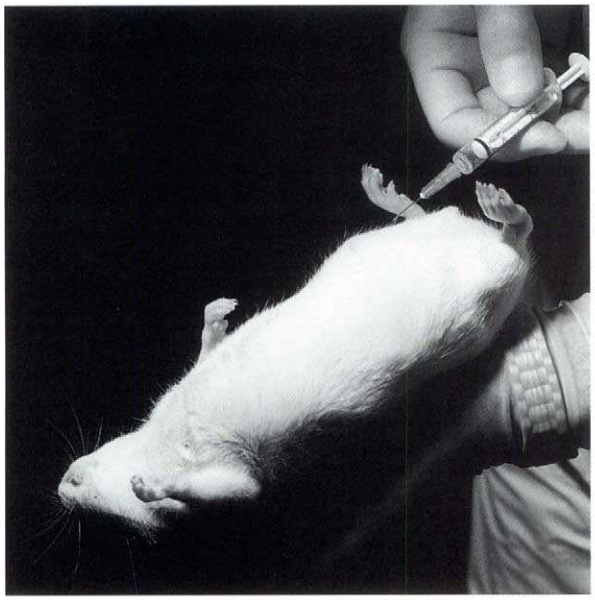

Figure 3.13 Scruff restraint while administering via the intraperitoneal route.

Figure 3.15 An alternative method of restraint for subcutaneous injection.

Subcutaneous administration

It is possible to slide the needle between the thumb and first finger and into the subcutaneous space in the animal's scruff. Care must be taken to avoid puncturing either digit with the needle (Figure 3.14) and it might be found to be safer and more convenient if the animal is placed on a horizontal surface and gentle pressure exerted from above whilst the injection is performed (Figure 3.15).

Intramuscular administration

Although the type of restraint will be similar to the previously described methods, administration by this route will require two people – one to restrain the animal whilst the second person extends the rat's rear leg with one hand to expose the muscle mass and uses the other hand to deliver the injection (Figure 3.16).

The subject of administration routes will be discussed in more greater detail in Chapter 24.

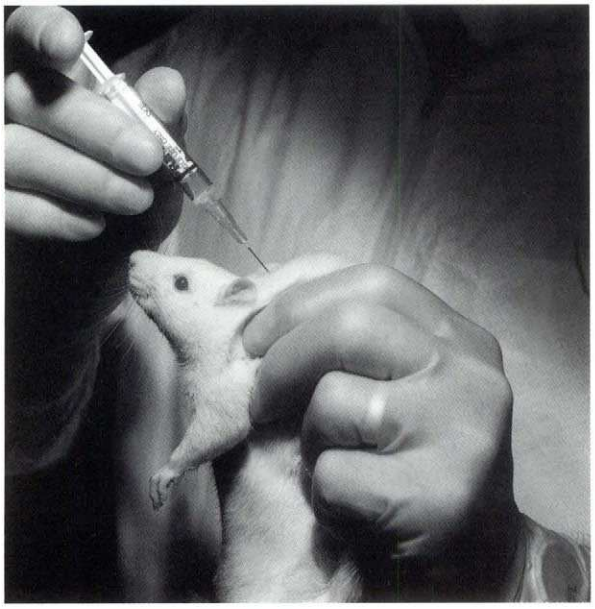

Figure 3.14 Scruff restraint while administering a subcutaneous injection.

Figure 3.16 Restraint for intramuscular injection using two people.

Restraining Devices

The use of some form of restraining device will be necessary for longer term immobilization or for administration techniques requiring the use of both hands. There are numerous types and designs of restraining devices, some available commercially whilst others have been successfully designed and fabricated within the laboratory. One of the commonest reasons for using a restrainer is to allow easy access to the rat's tail for either intravenous administration or tail vein bleeding. Some restrainers are, however, designed to give access to other parts of the animal's body.

Simple injections, for example intraperitoneal or intravenous into a superficial vein, only require short-term restraint usually lasting less than one minute. This duration of restraint should cause little stress to the animals, particularly if they are allowed to become accustomed to the method of restraint beforehand. It may, however, be necessary to restrain a rat for longer periods of time, in which case serious thought should be given to the reason why restraint is necessary, the length of time the animal must be restrained and the various methods that are available. The least stressful method of immobilization is by chemical means using an anaesthetic or, perhaps, a combination of a sedative or a tranquillizing agent with some form of physical restraint. If the experimental requirements preclude the use of chemical agents, the rat will have to be physically immobilized by confining it within some form of restraining tube or cage. The use of these devices can be extremely stressful to rats of all ages. In fact one of the most commonly used methods of inducing gastric ulcers in rats is by restraint over a period of several hours. Restraint time must, therefore, be kept to an absolute minimum and time devoted to accustoming the rats to the device before the procedure commences will help reduce the degree of stress the animal is exposed to.

The simplest method of short-term restraint is to wrap the animal in a piece of fabric. This method is cheap but, importantly, readily acceptable to the animal whilst also providing effective restraint for minor procedures. Muslin is an ideal material as it is fairly soft and will give a little as the animal moves. This small amount of movement, whilst appearing to contribute to the comfort of the rat, should not normally cause any problems and minor procedures may be performed successfully. The rat is placed on the muslin, a fold of material cast over its back and tucked beneath it and the animal then gently rolled over once or twice, wrapping it in the material but leaving its head and tail free. This method of restraint provides easy access to the tail for bleeding or intravenous administration but it is advisable to enlist the help of an assistant, who can carry out the wrapping and unwrapping process and also place a hand over the wrapped animal whilst the procedure is carried out. Following the procedure the animal can easily be removed, taking care to ensure the legs or feet do not become entangled in the material. Waynforth and Flecknell (1992) describe a similar method of restraint using the DecapiCone. This is a triangular-shaped polyethylene sleeve designed for restraint prior to euthanasia by decapitation. They state that DecapiCones can be used to immobilize rats for both subcutaneous and intraperitoneal injections with the needle being inserted through the polyethylene membrane and into the injection site. The use of these sleeves allows these techniques to be performed by a single person.

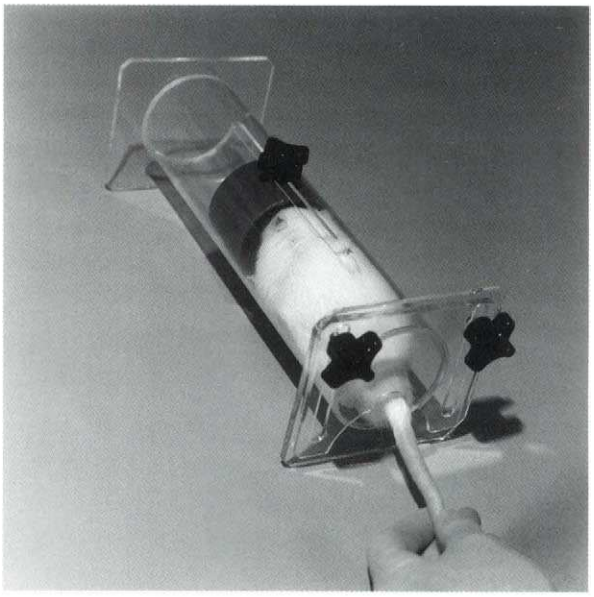

Figure 3.17 A plastic tube rat restrainer (International Market Supply, Congleton, Cheshire, UK).

Tubular clear plastic restrainers are commonly used for immobilizing rats for tail vein administration or bleeding. Many types are available but the design principle is similar. In the restrainer shown here (Figure 3.17) the rat, held by the base of the tail, is encouraged to crawl inside the restraining tube and the vertically sliding backplate lowered and locked into place. Care must be taken not to physically trap the tail. Whilst still holding the rat's tail, the adjustable head ring is slid down the tube to restrict any forward movement and is also locked into place.

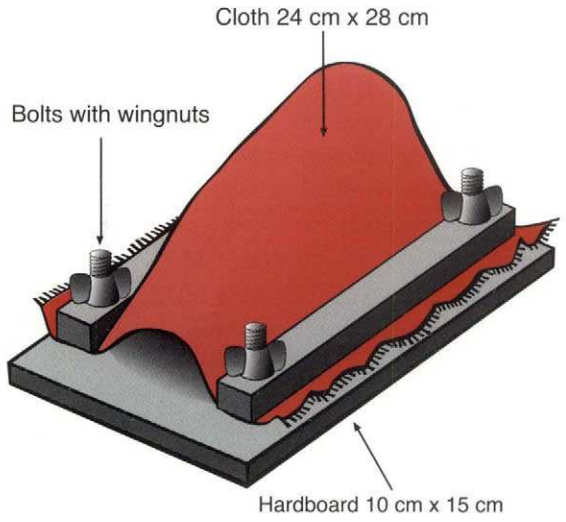

Figure 3.18 A simple 'home-made' restrainer for longer term restraint.

The head ring is perforated so as not to inhibit the captive animal's breathing. By mounting the restrainer in a retort stand the height and angle of the tube can be adjusted, making the subsequent procedure easier to perform and, therefore, more comfortable for the operator. This is particularly important if the procedure is to be performed on a large batch of animals. It is unlikely that problems will be encountered in persuading the animal to enter the tube as this is a natural rat behaviour that appears to have been retained from their wild predecessors. In fact it is often more difficult to entice the rat into leaving the tube once the procedure has been completed! The diameter of the restrainer tube should be sized so as not to allow the animal sufficient space to turn once inside. It is advisable to have a range of tubes with different diameters to cater for animals of differing sizes. Some restrainers are designed to allow access to other parts of the rat's body in addition to the tail and with some designs it is possible to administer both subcutaneous and intraperitoneal injections through an appropriate opening in the tube wall. Tube restrainers are only ideal for immobilization over short periods as heat dissipation can be a problem. Longer periods of restraint can lead to increased discomfort in the animal.

Owen *et al.* (1984) reported some agitation amongst rats whilst being persuaded to enter plastic restraining tubes and a high degree of stress in animals maintained there for upwards of one hour. They describe an alternative, simple method of restraint which they showed to be less stressful. Their restrainer comprised a base board on which a piece of cloth is held between two wooden bars. Each bar is fastened to the board by two wingnuts. The rat enters a tent of material between the two bars and the fabric is then pulled tight to fit snugly around its back. The wingnuts are then tightened to secure the animal (Figure 3.18). The animals readily entered the cloth restrainer and remained there for several hours at a time with no outward signs of discomfort. Rats housed in plastic tubes for an hour, however, were extremely agitated, showing gnawing and scratching behaviour and often vocalization. A commercially available restrainer operating on a similar principle to their version is now available. In this design the rat is restrained between two layers of nylon netting which are held on a fully adjustable stainless steel frame (Figure 3.19). Rat restraining harnessess are also available. Fitted with adjustable Velcro sides these can be used for rats of different sizes and can then be attached to an adjustable holding frame (Figure 3.20).

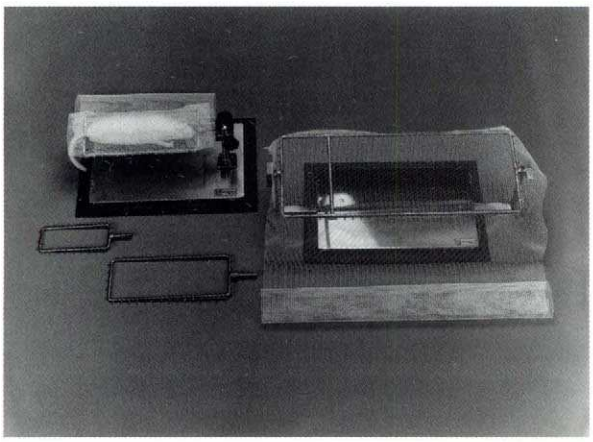

Figure 3.19 Nylon net restrainer and stand (Scanbur, Koge, Denmark).

Long-term Restraint

The problems of long duration restraint and its effect on the rat have already been discussed in this chapter. Historically much of this type of restraint followed surgical intervention and was necessary to protect a wound or prevent interference with an indwelling infusion line. The development and use of tethering equipment has now made other forms of restraint for these purposes obsolete. The rat is fitted with a jacket that is then fastened with hooks and Velcro. The catheter is protected by a stainless steel tether attached to a swivel device. This allows the rat ample movement within the cage but,