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DO-IT-YOURSELF REMOTE CHEMICAL IMMOBILIZATION EQUIPMENT

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Abstract – A do-it-yourself method for the assembly of remote chemical immobilization equipment is described. The dart syringes are basically made up of components from conventional 2,5 ml capacity disposable plastic syringes. A blow-pipe made of metal, plastic or glass with suitable dimensions is used as a propelling apparatus for the dart syringe. The accuracy obtained over 5 m by practically all people, novices included, makes this technique ideally suited for all caged animals and animals with limited escape range. Further merits accredited to this system were inexpensiveness, wide scope for improvization, simple construction, easy to use, reliability and consistency in operation, gentle impact and minimal tissue damage. Minimal disturbance was invariably caused to the subject animals.

Introduction

Great progress has been made in the field of remote chemical immobilization during recent years. There seems to be general agreement (Pienaar 1973a; Harthoorn 1976) that an initial relatively crude technique has been altered and moulded into a safe and reliable procedure through the use of more sophisticated equipment media and more suitable drugs. The technique has in fact become an exceedingly important scientific tool in the hands of wildlife veterinarians, biologists and nature conservationists. Yet, few veterinarians seem to make use of this technique. The general opinion of the field veterinarian in South Africa is that the initial financial outlay does not warrant the limited scope of application in their own field. Pienaar (1973a) maintained that the Palmer "cap-chur" immobilizing equipment is the most universally obtainable and popular apparatus in use for drug immobilization of wild and domestic animals. Yet, to get rigged out with the least expensive of the Palmer equipment, the short range projector (pistol), dart syringes and other necessary sundries will cost the operator R200 to R300 in South African currency (Anon. 1977). Very little doubt therefore exists that immobilization equipment is basically expensive and justifies the attitude of the general field veterinarian with no or very few wild animal or exotic pets under his care.

However, in the course of my work as a wildlife veterinarian I have come across and further developed a technique which is cheap and simple to construct and is within the practical and financial grasp of every person working with animals, wild or domesticated.

In this report it will be shown how this technique works, with results obtained in actual practice and a discussion on its limitations and applicability.

Assembling the dart syringe

The "do-it-yourself" dart syringes are basically made up of components from ordinary disposable plastic syringes with detachable rubber plungers. In order to convert such a conventional syringe into a dart syringe two methods are presented:

Method 1: *Air pressurizing principle.*

As depicted by Fig. 1 the syringe is disassembled (Fig. 1,b) and the rear flanges of the barrel removed (Fig. 1,c). It can easily be cut off with an ordinary pocket knife.

Two plungers are now inserted back-to-back into the syringe barrel (Fig. 1,c & d). It is, however, advisable to apply silicone grease lightly to the inside of the barrel and liberally to the plungers before insertion into the barrel. A small brush or a piece of flannelette tied around a stick is ideally suited to the task. If silicone grease is not available, petroleum gel can be used as a substitute.

The rear part of the syringe barrel is now heated over an open flame until the plastic becomes soft and pliable (Fig. 1,d). The tassel stabilizer, manufactured as illustrated in Fig. 2, is then inserted into the barrel and the heated soft part moulded around the body of the tassel (Fig. 1,e).

In an emergency a cigarette lighter or even a match can be used as a flame source. If forced to improvise, any light fluffy material can be used as a stabilizer, even a piece of cotton wool.

As shown in Fig. 1, a simple injection needle completes the assembly. Although a disposable needle with a plastic mounting was found quite adequate, the heavier weight of a totally metal needle resulted in an aerodynamically more stable design and provided for greater accuracy of the missile. It also withstood greater punishment.

The best multi-purpose needle was found to be an 18G1½ (1,25 mm x 38 mm) sized needle. For very small animals the needle cannula can, however, be shortened to about 20 millimeter.

The fluid, when under pressure in an activated dart syringe *(vide infra)*, is retained by a short length of close-fitting portex tubing which is heat sealed at one end and fitted over the point of the needle cannula. The tubing must be close-fitting and able to withstand the pressure. For the 1,25 mm x 38 mm needle, 1 cm lengths of 1,1 mm inner diameter portex tubing was found ideal.

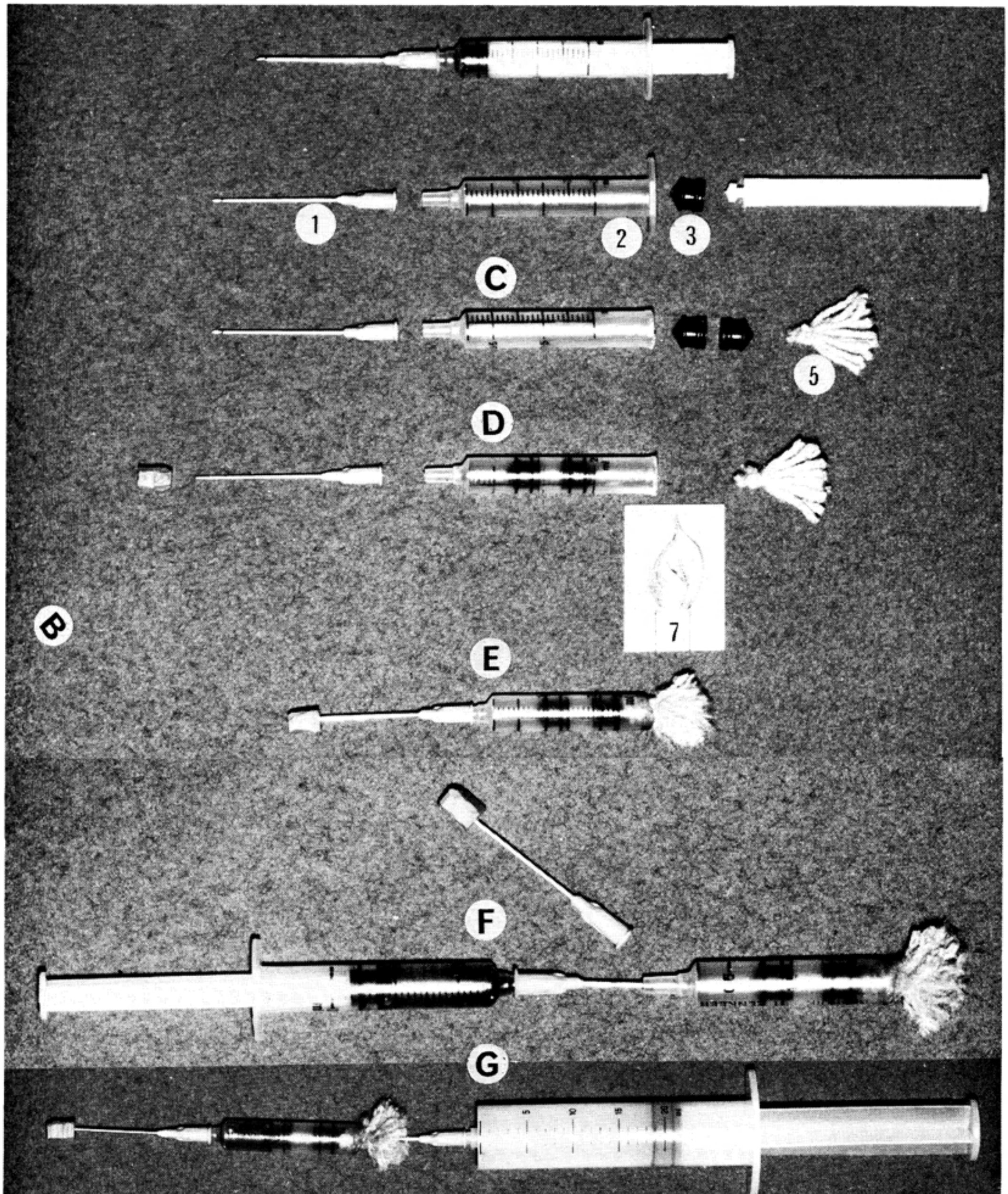

Fig. 1. Conversion of a conventional plastic disposable syringe into a dart syringe, utilizing the air pressurizing principle. The stages are alphabetically marked. The essential components are: 1. Needle. 2. Syringe barrel. 3. Neoprene plunger. 4. Plunger shaft. 5. Tassel stabilizer. 6. Rubber stopper. 7. Flame.

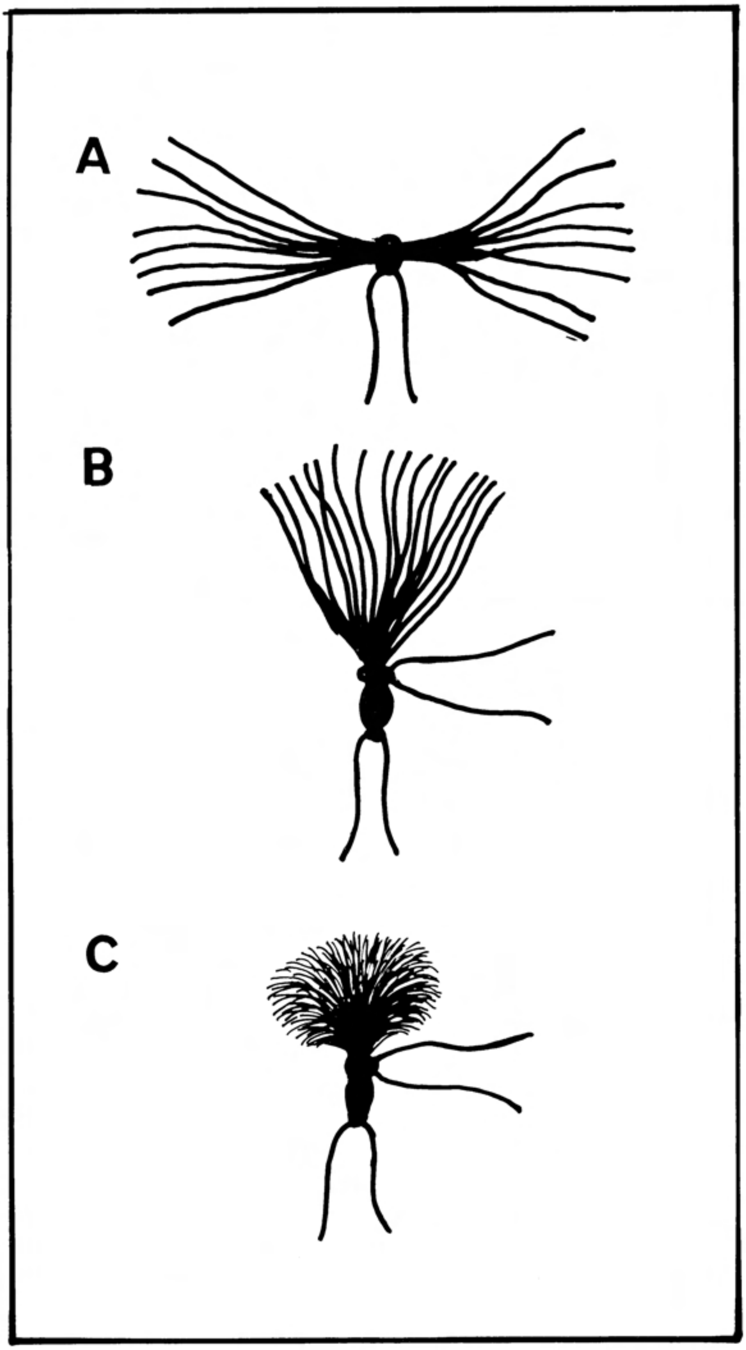

Fig. 2. Tassel stabilizer made from ordinary strands of knitting wool. The steps (A–C) are self-explanatory. Step C: The strands are fluffed with a needle and afterwards trimmed down to a ball shape.

If portex tubing is unavailable, a small piece of solid rubber can be stuck onto the needle point (Fig. 1,d & e). Easily available solid or dense rubber sources are rubber stoppers and old motor vehicle tyres. Such an improvized rubber cap should, however, be trimmed down to minimize influence on the trajectory or flight of the missile.

It is also advisable to test the blocked needle for leakage beforehand. This can easily be done by exerting pressure with an ordinary syringe.

An alternative and superior needle design is, however, shown by Fig. 3, insert. The front end of the cannula is permanently blocked off by soldering and an alternative route provided by opening up a small hole in the needle shaft. This in turn can then be blocked off by sliding a small piece of rubber over the hole. Rubber plungers from dentistry nerve block vials were found ideal for this purpose.

Fig. 1,f shows how the drug is injected through the nozzle of the dart syringe.

Afterwards the capped or blocked needle is fitted on. This is done with a screw-on action in order to ensure leakfree usage under pressure.

Just before action is due to take place the dart syringe is activated by inserting a needle through the tassel stabilizer and through the rear neoprene plunger into the space between the two plungers as depicted by Fig. 1,g. Obviously then, the thinner the cannula of the pressurizing needle, the longer the expected life of the dart syringe will be. The needle is attached to a 10 ml syringe which is filled to capacity with air. The air is then forced into the space. When no further pressure can be introduced manually, the needle and syringe is removed in a quick movement whilst still under pressure.

The pressure introduced into the interplunger space now exerts a pushing action onto both plungers. The rear one comes to rest against the mechanical barrier formed by the tassel stabilizer and moulded-in syringe body, whilst forward movement and spillage of the drug is counteracted only by a close-fitting blocked-up needle. However, once the dart syringe hits the target, the rubber (or tubing) on the needle is pierced or slid back along the shaft and sets the forward movement of the front plunger and drug free. If a muscular area on an animal is hit rectangularly, intramuscular deposition of the drug is invariably produced.

After repeated usage and puncturing of the rear plunger, the rubber material loses its ability to maintain high pressure. The front plunger, being undamaged can, however, still be salvaged and used as a rear plunger in a newly manufactured dart. By initially filling up the hollow of the rear plunger with any commercially available rubber compound which may stop air leakage on back pressure, the useful life of the dart syringe can be drastically prolonged. In tests, applying these measures, dart syringes were re-used up to 50 times without causing leakage.

Method 2: *Compression spring principle*

The basic principles as described for Method 1 also apply to this method. The only differences are provided by the pressure producing agent in the dart and the flight or tail stabilizer.

Figure 3 shows the different stage of construction. In the first step (Fig. 3,a) it can be seen that additionally a compression steel spring is required. This is commercially available or can be made up and should basically have the following features: Maximum outer diameter: 8,43 mm. Total number of coils: 12¼. Wire diameter: 0,81 mm. Free length: 44 mm. Solid height: 0,9 mm. Load at solid height: 2,3 kg.

The plunger is disassembelled from its shaft and the spring fitted over the end of the shaft. As depicted by Fig. 3,b, two window slits or catches are then cut in the rear end of the syringe body, which has already been denuded of its flanges as described previously. The slits are cut and placed opposite each other and hinge inwards so as to provide a catch for the distal collar of the plunger shaft. Provided the needle has been prepared as described previously and the plunger put in position (Fig. 3,c), the dart is now ready for use.

Just prior to use the drug is injected through the nozzle of the dart syringe (Fig. 3,c) and the needle replaced (Fig. 3,d), the drug is then pressurized by inserting the plunger shaft into the open end of the dart body and thereby compressing the coil spring. The plunger shaft is then fixed in this position by the catches provided therefore *(vide supra)*. The dart is now loaded and ready to be fired (blown).

Instead of the window slits an ordinary dressmaker's pin can be pushed through the distal end of the dart and through the plunger shaft, fixing it in an appropriate position. The pin is then cut off flush with the body on both sides.

The spring coil method is considered superior to the air pressurizing method in the following ways: It is aerodynamically more stable, it is easier and faster to construct and is more sturdy in use.

A 100 cm–200 cm long alluminium drawn tubing, inner dimension (ID) 12,5 mm, outer dimension (OD) 15,8 mm, was found very satisfactory as a propelling or launching apparatus for the dart-syringe.

Any smooth-bored metal, glass or rigid plastic pipe, with ID slightly bigger than the OD of the dart syringe, can however be used. If forced to improvise, even ordinary conduit tubing or waterpiping with suitable inner dimensions can be used. Inner roughness of the pipe will, however, retard the flight of the dart syringe somewhat, limiting the affective range of application.

The dart syringe is inserted into the pipe. The propelling force behind the dart is then provided by blowing into the rear part of the blowpipe by mouth. It is important to start the blowing as an explosive action and to maintain positive pressure until the dart syringe leaves the barrel of the blowpipe on its way towards the target.

Over short distances the dart syringe can be delivered with remarkable accuracy. In test patterns "fired" over a distance of 5 m, five people with very limited experience achieved an average grouping of 15 cm and hit a

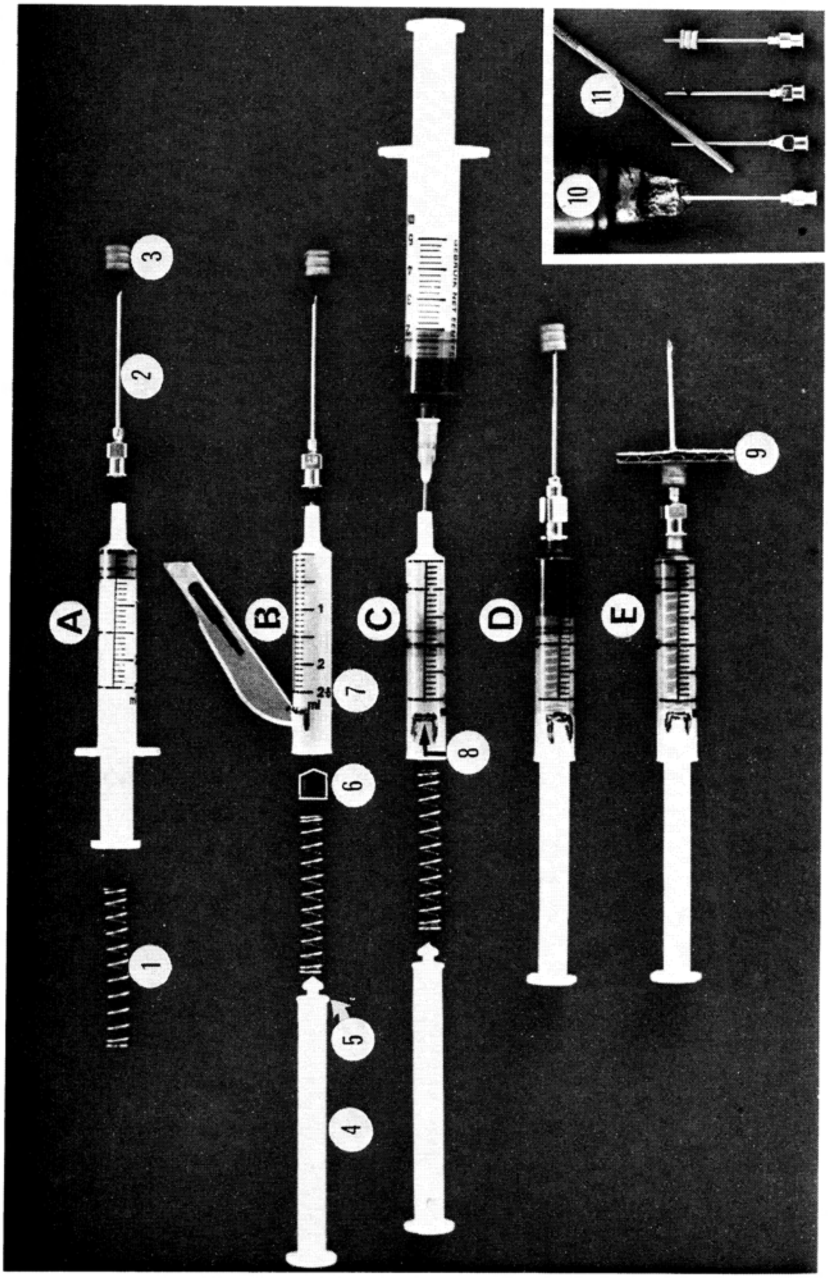

Fig. 3. Conversion of a conventional plastic disposable syringe into a dart syringe utilizing the compression spring principle. The stages are alphabetically marked. The essential components are: 1. Compression spring. 2. Needle. 3. Rubber stopper. 4. Plunger shaft. 5. Collar of plunger shaft. 6. Plunger. 7. Syringe barrel. 8. Catch or slit (one each side of barrel). 9. Simulation of animal skin. 10. Soldering bolt. 11. Small file.

bulls-eye of 2 cm diameter twice out of every five attempts. Operative distances of up to 10 m–12 m were obtained by experienced people.

The accuracy obtained over 5 m by practically all people, novices included, makes this instrument ideally suited for all caged animals with limited escape range.

Momentum and concominant accuracy with which the dart syringes are delivered can be effectively increased by fitting a mouthpiece onto the blowpipe. An ordinary mouth piece which is used for the snorkel of a skin diving apparatus, was found quite suitable and increased the effective range by about 20 percent.

In spite of the dart syringes being manufactured from disposable plastic syringes, the material was found to be strong enough to allow for repeated usage. In a test five darts were "fired" 50 times into a tree over a range of 3 m without damage occurring.

Costs

Current (early 1979) South African prices for disposable plastic syringes are in the vicinity of 7c to 10c each, whilst aluminium drawn tubing (ID 12,5 mm), which is recommended as a blowpipe, sells at about 50c per metre length. Commercially available compression springs, as specified, cost about 10–15 cents each. It therefore follows that an initial outlay of such remote chemical immobilization equipment will cost the operator less than R1,00, which is considerably cheaper than any other comparable equipment on the market.

Immobilizing or tranquilizing agents

Etorphine hydrochloride (M99, Reckitt & Sons) is readily soluble in slightly acidified water to a concentration of 5 mg/ml, whilst solutions of double this strength may be made in dimethyl sulphoxide (Harthoorn 1973). In the same way Fentanyl (Janssen Pharm.) has been made up to 100 mg/ml. During the experimental phases of the drug, R33799 (Janssen Pharm.), a derivative of fentanyl, was provided as a 10 mg/ml solution (De Vos 1978). The commercially available phencyclidine hydrochloride solution (Sernylan, Bio-Ceutic Laboratories, Inc.) is provided at 100 mg/ml. Sernylan in powder-form is, however, available and can be made up to a solution of 200 mg/ml. The same applies to Ketamine (Ketalor, Park-Davies & Co.) which is marketed in a 10 mg or 50 mg/ml solution. The powder is, however, readily soluble in water and can be made up to 20% or more, at a pH or 3,5 tot 5,5 (Harthoorn 1976). Xylazine hydrochloride (Rompun, Bayer) is also available in powder form and can be made up to a strength of 500 mg/ml in the diluent provided by the firm. If necessary azaperone (Janssens Pharm.) can be made up to a strength of 200 mg/ml.

Tiletamine hydrochloride (CI-744, Parke, Davis & Co.) is suggested as an alternative to Sernylan which is currently hard to obtain owing to the fact that production has been interrupted on account of human health considerations. Tiletamine is freely soluble in water up to a concentration of 30 percent.

Looking at the recommended dosage rates (Pienaar 1973b; Harthoorn 1973, 1976; Ebedes 1973; De Vos 1978) the dart syringe capacity in relation to drug strengths leaves ample leeway to effectively tranquillize or chemically immobilize any terrestrial wild animal. Conventional 2,5 ml disposable syringes will provide for an effective drug capacity of up to 1,2 ml when converted into a dart syringe.

The general field veterinarian should, however, not start off by procuring very expensive drugs like M99. For general practice Sernylan, Ketamine or Tiletamine and Rompun should suffice. Sernylan, Ketamine or Tiletamine should be able to account for any dog or cat, whilst Rompun will effectively sedate or put down any domestic bull when used as a solution of 250 mg–500 mg/ml.

Implementation

This technique was tested on small as well as big animals and on thin-skinned as well as relatively thick-skinned animals. In all instances effective penetration occurred. Intramuscular drug deposition as shown by very satisfactory drug responses, was affected in each case. In tests the following animals were immobilized successfully in this manner: Vervet monkeys *Cercopithecus pygerythrus,* Chacma baboon *Papio ursinus,* warthog *Phacochoerus aethiopicus* and African buffalo *Syncerus caffer.*

Minimal tissue damage was caused, even in the smallest animal tested, which was a 1,5 kg Vervet monkey. A relatively mild impact, light-weighted dart syringe, a thin, sharp, smooth needle cannula and spontaneous passive retraction are factors which are considered instrumental to the mildness of this technique. In comparison the available short range pistol applicators sometimes cause severe bruising, open wounds or even bone fractures in small animals over short distances. This was in fact the reason which initiated the search for something less severe and which culminated in the presented technique.

The disturbance factor is also kept to a minimum. The relative soundlessness with which the excercise starts off, combined with the lightweightedness, sharp needle, mild impact and passive retraction of the dart syringe causes a very slight and only transient fright reaction in wild animals. This should be even less in domestic species.

This method is therefore ideally suited for the excitable type of animal, wild as well as domesticated species.

In the ordinary field of veterinary medicine working with domestic animals the prediction is ventured that once the field veterinarian starts applying the technique, he will find numerous instances where it can be used to his advantage. Why should a person risk injury or maybe even his life with a wild animal, a recalcitrant domestic bull or a suspected rabid dog, if a perfectly practical, safe and relatively cheap method of remote chemical restraint exists?

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