



Reviewing **Artificial Insemination Technique**

Within the cattle industry there has been a shift away from hiring professional technicians to artificially breed cattle and toward artificial insemination by owner-inseminators. Such a trend should not suggest that artificial insemination (AI) is an easy technique or that all owner-inseminators are proficient in AI. The pregnancy rates achieved by owner-inseminators differ by as much as 23 percent. Obviously, not all inseminators have acquired the skill to obtain consistently high conception rates in their cattle.

Most breeding organizations offer instruction in AI technique, but the overall quality, intensity of training, and specific recommendations may vary considerably among instructional programs. Most agricultural colleges devote a whole course or part of a course to the technique of artificial insemination.

In developing the manual skills needed for insemination, trainees should work with numerous reproductive tracts and receive considerable practice inseminating a variety of live cows. Developing the skill to thread the insemination rod through the cervix should not be the only objective. AI training programs should also emphasize the importance of sanitation and the perfection of skills to consistently identify the proper site of semen deposition and to accurately deposit the semen. In addition, trainees should obtain a good understanding of reproductive anatomy and appreciate the essentials of a sound reproductive management program.

While artificial insemination proficiency of professional technicians is monitored by nonreturn rates (calculated by the breeding organizations), the

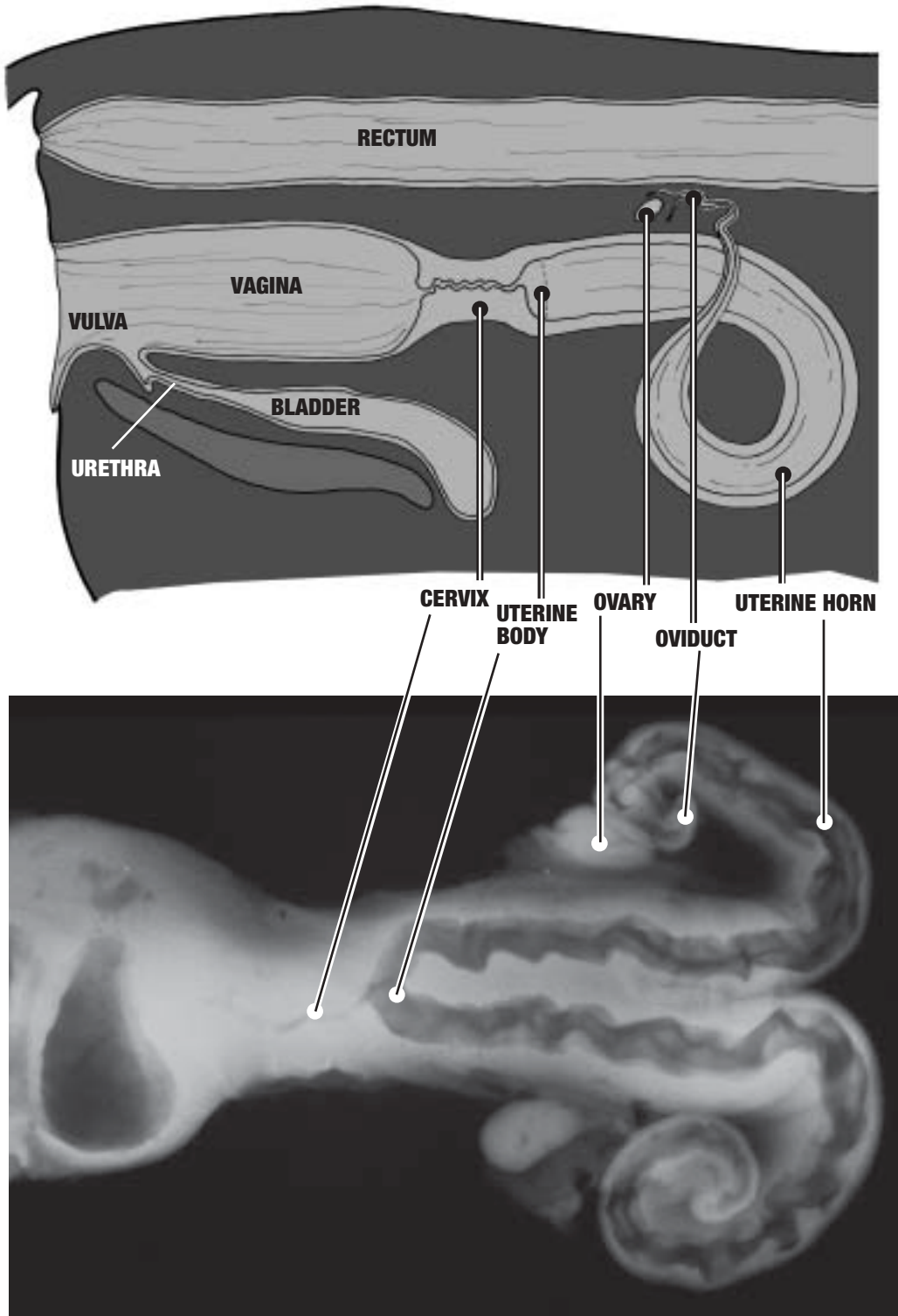
conception rate obtained by owner-inseminators is not monitored and routine retraining generally is not provided. The purpose of this fact sheet is to provide a review for those individuals already familiar with the AI technique, with special emphasis on reproductive anatomy, sanitation, and accuracy of semen deposition.

Reproductive anatomy

In the early days of AI there was controversy among researchers about the optimum site for semen deposition. A study conducted in Canada provided evidence that fertility was highest when semen was deposited in the uterine body. Researchers currently are reexamining insemination technique to determine the proper site of semen deposition.

Failure to understand the anatomical and functional relationships among the various tissues and organs of the reproductive system may lead to consistent insemination errors. Most AI training schools use excised tracts to illustrate reproductive anatomy. Often the tracts are dissected to allow students to view the interior of the uterus. This is a useful exercise; however, dissection can distort the relationship between various regions. Figure 1 is an illustration of the reproductive anatomy of the cow and a radiograph (photograph of an X-ray) of the cervical region and uterus. Radiography allows students to view the intact tract and simultaneously observe the interior of the uterine body and horns and, in many cases, the cervical canal.

Figure 1. Diagram (side, or lateral, view) of the reproductive anatomy of the cow and radiograph (top, or dorsal, view) of the cervix, uterine body, and uterine horns.



The uterine body is the area between the internal cervical os and the internal uterine bifurcation, where the uterine horns begin to separate inside the reproductive tract. In measurements taken from radiographs of 580 reproductive tracts, this distance averaged 5/8 of an inch. Two-thirds of the tracts had a uterine body length between 3/8 and 7/8 of an inch. Obviously, there is not much room for error in placement of the insemination rod tip.

While palpating the reproductive tract to find the landmarks for insemination, the inseminator usually obtains an idea of the overall size of the reproductive tract. Some inseminators may have the impression that the larger the cervix or the longer the reproductive tract, the larger the uterine body. This assumption is incorrect. Insemination errors can result from such misconceptions about size of the uterine body in relation to the overall size of the reproductive tract.

Preparations for insemination and sanitation

Here are some important steps to follow and points to remember:

- Ensure that the cow to be bred is truly in heat. Research studies indicate between 7 and 20 percent of the cattle inseminated are not in heat.
- Restrain the cow first and then thaw the semen. The restraint area should be familiar to the cow and free of stressful conditions. Unnecessary excitement may interfere with physiological mechanisms important to achieving a good conception rate.
- Develop good sanitary procedures and insemination practices. It is easier to learn good habits than to break bad habits.
 - a. Insemination supplies should be kept dry and clean at all times. Breeding sheaths should be stored in the original package until used.
 - b. Once the insemination device is assembled it must be protected from contamination and cold shock temperatures.
 - c. Materials used to lubricate the rectum should not come in contact with the vulva region. Lubricants are generally spermicidal. Avoid using products that are irritating.
 - d. The vulva region must be thoroughly wiped clean with a paper towel. This is important in helping prevent the interior of the reproductive tract from becoming contaminated and possibly infected. A folded paper towel can be inserted into the lower portion of the vulva. The insemination rod can then be placed between

the folds of the towel and inserted into the vagina without contacting the lips of the vulva.

- e. Protective rods or sheaths are used in herds or for specific cows where vulvovaginal infection is a problem. When this system is used, the standard insemination rod and plastic sheath are inserted into the larger protective rod or sheath. This double rod combination is passed through the vagina to the external cervical opening. At the cervix, the tip of the protective device is punctured by the insemination rod, which is then threaded through the cervix. This technique should only be used following the recommendations of a veterinarian, extension specialist, or AI representative — and only when specific diseases have been diagnosed or suspected.

General tips for insemination technique

- To avoid the possibility of entering the urethral opening on the floor of the vagina, the insemination rod should be inserted into the vulva upward at a 30° to 40° angle.
- The anterior portion of the vagina, termed the fornix vagina, tends to stretch rather easily when the insemination rod is pushed forward and beyond the cervix. This may give the false impression that the rod is advancing through the cervix, when indeed it is above, below, or to either side of the cervix. The inseminator should be able to feel the rod within the vaginal fold, but unable to feel the rod tip within the cervix.
- Remember to place the cervix onto the insemination rod. Maintain slight forward pressure on the rod while manipulating the cervix slightly ahead of the rod.
- The target for semen deposition, the uterine body, is quite small (Figure 1). Accurate rod tip placement is probably the most important skill involved in the whole AI technique. Inseminators generally identify this target area by feeling for the end of the cervix and the tip of the rod as the rod emerges through the internal os or opening. Depositing the semen in the cervix or randomly in the uterine horns may result in lower conception rates.
- Once the rod tip is aligned with the internal cervical os, deposit the semen. Semen deposition should take about five seconds. Slow delivery maximizes the amount of semen delivered from the straw and minimizes the unequal flow of semen into one uterine horn.

- During the process of semen deposition, take care that the fingers of the palpating hand are not inadvertently blocking a uterine horn or misdirecting the flow of semen in some manner.
- Be careful not to pull the insemination rod back through the cervix while the semen is being expelled.
- If the cow has moved during semen deposition or you think the rod has moved, stop the semen deposition and correctly reposition the rod tip before continuing semen deposition.

Accuracy of insemination

Critically evaluating the accuracy of insemination has been difficult. For many years, the dye method was used to evaluate the proficiency of professional technicians. Excised reproductive tracts were inseminated with a biological dye in place of semen. In some cases, live cows were inseminated with dye and the tracts were examined immediately after slaughter. The location of the dye within the tract indicated the site of semen deposition.

Table 1 summarizes the results of dye inseminations in live cows and relates the results to the field performance of technicians (60- to 90-day nonreturn ratings). Nonreturn rate is an indirect measure of fertility. Technicians with a nonreturn rate greater than 78 percent achieved 86 percent of their dye depositions in the uterine body and they had no extrauterine inseminations. Inseminations by

Table 1. Percentage of dye depositions in various regions of the reproductive tract by inseminators with low and high breeding efficiency.

	Efficiency	
	Low	High
Inseminations (number of)	256	28
Site of depositions (percentages)		
Uterine body	34	86
Right uterine horn	31	14
Left uterine horn	4	0
Total uterine depositions	69	100
Anterior cervix	9	0
Posterior cervix	16	0
Vagina	6	0
Total extrauterine depositions	31	0

Adapted from Graham, E. F. 1966. Proc. First Technical Conference, National Association Animal Breeders.

technicians with nonreturn rates below 70 percent resulted in only 34 percent of the dye depositions in the uterine body and 31 percent extrauterine inseminations. It appears that accurate semen deposition is correlated with successful conception rates.

The dye method has some limitations. The location of the insemination rod tip cannot be determined, and manipulation of the reproductive tract during slaughter or dissection can distort the distribution of the dye.

Researchers at The Pennsylvania State University have used radiography to evaluate insemination technique accuracy. This method allows the interior of the tract to be viewed without dissection and the location of the insemination rod to be easily seen. Twenty professional technicians and twenty owner-inseminators were evaluated by this technique. Each participant inseminated twenty reproductive tracts. Two radiographs were evaluated for each insemination. The first was taken after insemination rod placement and the second after semen deposition. Placement of the rod tip was assessed from the first radiograph and distribution of semen from the second.

Analysis of radiographs of all inseminations indicated that only 39 percent of the rod tip placements were within the uterine body. Placements in the cervix, right uterine horn, and left uterine horn were 25, 23, and 13 percent, respectively. Semen distribution, determined from the second radiograph, showed that 40 percent of the semen was located in the uterine body or equally distributed in both uterine horns. The remaining 60 percent was located in the cervix or disproportionately in one uterine horn. Accurate distribution of semen was significantly related to proper placement of the insemination rod. Figures 2a and 2b illustrate correct rod tip placement and semen distribution. Figures 2c, 2d, 2e, and 2f illustrate examples of incorrect AI technique.

No differences were found between professional technicians and owner-inseminators in their abilities to place the rod tip accurately or to distribute the semen properly. However, considerable variation was found among all inseminators in their ability to position the insemination rod correctly. Among all the participants in this study, the percentage of correct placements within the uterine body ranged from 0 to 85 percent of the insemination attempts. These individuals are probably a representative sample of professional technicians and owner-inseminators breeding cows throughout the country. The results clearly indicate that consistent placement of the rod tip within the uterine body is a difficult task. Accurate insemination technique requires

Figure 2. Radiographs of excised cow reproductive tracts illustrating insemination rod tip placement (left) and distribution of radiopaque semen (right) following correct AI technique (a, b) and incorrect techniques (c, d, e, and f).

ROD TIP PLACEMENT

SEMEN DEPOSITION

CORRECT TECHNIQUE



**INCORRECT TECHNIQUE,
CERVICAL INSEMINATION**



**INCORRECT TECHNIQUE,
UTERINE HORN INSEMINATION**



mental concentration, attention to detail, and a clear understanding of reproductive anatomy, as well as the ability to identify the target area and properly position the insemination rod. The variation seen in this study and in other studies suggests that certain individuals have acquired or perfected these skills to a much greater degree than others. It further demonstrates the need for routine retraining and updating of both professionals and owner-inseminators.

Subsequent to the Penn State study, research from Washington State University showed that retrograde movement of sperm into the vagina was 2-fold greater following cervical semen deposition compared to uterine deposition. Cervical semen deposition results in significant loss of sperm.

Evaluating success and need for retraining

Owner-inseminators should calculate the first-service conception rate for their herds during a 6-month interval. They should review breeding charts and consider only those cows that have been bred long enough to have been pregnancy checked. Strive for a goal of 45 percent first-service conception rate. In smaller herds there may not be enough first service during a 6-month period to determine the conception rate accurately. In that case, inseminators should summarize first services over 12 months or calculate the percentage of cows pregnant after three breedings. In very large herds, calculate conception rate more often than every 6 months.

In any size herd, services per conception is another index of breeding performance related to the effectiveness of insemination technique. A reasonable goal is to maintain a rate of fewer than 1.8 services for pregnant cows. Livestock producers must realize that other factors in addition to AI technique can affect conception rate and services per conception.

If an evaluation of your records indicates that your insemination technique may be a problem area, then you should consider attending an AI retraining session. The effectiveness of retraining can be seen in Table 2. If the magnitude of improvement is 8 percent for professional technicians, it may be even greater for owner-inseminators.

All inseminators should periodically attend a retraining course to review their technique, learn new developments, and obtain recommendations regarding AI technique.

Table 2. Effect of retraining professional technicians using the dye deposition technique.

Number of Technicians	Breeding efficiency (% nonreturn rate)	
	4 months before retraining	4 months after retraining
13	62.5	70.5

Adapted from Graham, E. F. 1966. Proc. First Technical Conference, National Association Animal Breeders.

References

Peters, J. L., P. L. Senger, J. L. Rosenberger, and M. L. O'Connor, (1984) "Radiographic evaluation of bovine artificial insemination technique among professional and herdsmen-inseminators." *Journal of Animal Science* 59, 1671.

Gallagher, G. R., and P. L. Senger, (1989). "Concentrations of spermatozoa in the vagina of heifers after deposition of semen in the uterine horns, uterine body, or cervix." *Journal of Reproduction Fertilization* 86, 1

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