



# The short scrotum method of castration in lambs: a review

---

## **PART 1**

This project, undertaken by FAI Farms Ltd with support provided by EBLEX, is a two part study into the short scrotum method of castration in lambs.

**Part 1** – a literature review of existing scientific papers

**Part 2** – replicated field trials, to be defined following the literature review

Ruth Clements MRCVS BVMS BSc

Dr Ashleigh Bright BSc MSc PhD

FAI Farms Ltd, The Field Station, Wytham, Oxford OX2 8QJ

Tel 01865 790880 [www.faifarms.co.uk](http://www.faifarms.co.uk)

# 1 Introduction

## 1.1 The practice of and need for castration

The practice of castration, using a tight rubber ring to eliminate indiscriminate breeding amongst maturing lambs, is widely carried out by sheep farmers in the UK and in other lamb producing countries. Castration of lambs is considered necessary for several interconnected reasons, all related to husbandry and productivity. Few benefits for the lambs can be recognised.

It is argued that castration of lambs facilitates their management (Farm Animal Welfare Council 1994, Hosie et al. 1996, Robertson 1965). After castration of male lambs, all lambs may be housed or grazed together, irrespective of their sex, without the risk of indiscriminate breeding. Castration is thought to reduce the development of secondary sexual behaviours, including aggression and mounting (Farm Animal Welfare Council 1994). This assumption has been quantitatively assessed in two and three week old pigs in which aggression, mounting and attempts at mounting, were reduced by both surgical and immuno-castration (Cronin et al. 2003). A reduction in aggression in both surgically and immuno-castrated bulls was also observed by (Price et al. 2003). No quantitative study on the effect of castration on aggression and mounting behaviours in sheep were found, but it is likely that castration has a similar effect on behaviour in this species. A reduction in secondary sexual behaviour is desirable as the risk to stockpersons may be reduced (although the risk must be considered much less from rams than from bulls or boars).

## 1.2 Current methodology and implications of standard castration

The use of the tight rubber ring method was introduced to the U.K from New Zealand in the early 1950's (Barrowman et al. 1953). The procedure may be carried out without the use of anaesthetic in lambs up to seven days of age (Ministry of Agriculture and Fisheries (NZ) 1996). Castration is frequently carried out alongside tail docking also with a tight rubber ring, which serves to reduce the problems associated with fly strike (French et al. 1992).

Research has demonstrated that the standard tight rubber ring castration procedure is associated with considerable acute and chronic pain in lambs and as such represents a significant welfare issue (Kent J.E. et al. 1997, Mellor and Murray 1989). Any alternatives to the standard tight rubber ring castration method, which might provide improvements in welfare standards, should preferably also demonstrate some economic and / or management advantages to the farmer if the method is to be successfully implemented. Any method imposing significant additional cost, in terms of equipment or cost of husbandry time, may suffer poor uptake and acceptance by the farming community.

## 2 The short scrotum method of castration

Standard rubber ring castration involves removal of the scrotum and testicles by the application of a tight rubber ring, which occludes the blood supply to these tissues by causing them to become, in turn, ischemic, necrotic and eventually to be shed along with the rubber ring (Wood et al. 1991). The short scrotum method of castration involves removal of the scrotum with a tight rubber ring as described above, while leaving both the testicles close to or in the inguinal canal, as in cryptorchids in situ.

Short scrotum castration of lambs has been used by some farmers, particularly in New Zealand (Lester et al. 1991). It is proposed that removal of the scrotum prohibits thermoregulation of the testicles at less than body temperature and thus the proximity of the testicles to the heat of the body wall renders the process of spermatogenesis ineffective.

During the last 50 years the method was studied in New Zealand and Australia with some research in the United States. Short scrotum castration is now used as a routine method of castration in New Zealand and Australia.

There has recently been interest in the short scrotum castration technique in the UK because of the possible welfare benefit. Below, we review research on growth rate, fertility, meat quality and welfare associated with short scrotum castration.

## 3 Carcass characteristics and growth rates in short scrotum lambs

Advantages in average daily gain and feed efficiency are well documented for intact and short scrotum rams over wethers (Glimp 1971; Schanbacher and Ford 1976; Schanbacher et al. 1980; Probert and Davies 1986; Hopkins et al. 1990; LeValley et al. 1994; Wellington et al. 2003). There is also evidence that intact and short scrotum lambs produce a leaner carcass (i.e., higher carcass grade) than wethers (Schanbacher and Ford 1976; Schanbacher et al. 1980; Probert and Davies 1986; Hopkins et al. 1990).

The growth and carcass benefits of short scrotum and intact lambs are due to testosterone secretion from the testes. Short scrotum rams have plasma LH levels intermediate to normal rams and wethers (Probert and Davies 1986) even though short scrotum rams have significantly lighter testes and epididymides than normal rams (Barenton et al. 1982; Probert and Davies 1986). Schanbacher et al. (1980) compared ram lambs, wethers and wethers implanted with Silastic capsules containing crystalline testosterone for differences in growth, performance and carcass characteristics. Growth rate, efficiency of feed utilisation and carcass yield of intact ram lambs and testosterone-implanted wethers, were superior to the corresponding traits of wethers.

Similarly, (Wellington et al. 2003) compared growth, endocrine function and carcass composition of 6 groups of rams with gonadal alterations. Wellington et al. (2003) found that circulating plasma testosterone and androstenedione concentrations were not markedly affected by any gonadal treatment except in bilaterally castrated lambs (wethers) and concluded that gonadal alterations which maintain androgen secretion produce beneficial effects, similar to intact rams on growth and carcass characteristics.

## **4 Fertility of short scrotum lambs**

### **4.1 Testicular weight and size**

Several studies (Schanbacher and Ford 1976, Hopkins et al. 1990; Wellington et al. 2003) measured comparative testicular size between entire and short scrotum lambs. Overall average testicular weights were found to be less in short scrotum lambs than in entire animals but with a high range (Schanbacher and Ford 1976, Hopkins et al. 1990). Studies have noted no correlation between testis size and growth rate (Hopkins et al. 1990). Hopkins et al. (1990) also correlated testicular size with presumed sperm production and concluded that due to variable testicular weight there would be the possibility of fertile animal.

### **4.2 Testicular Histopathology**

The first study to look at short scrotum testes by histopathology, quantitatively evaluated spermatogenesis and seminiferous tubule diameter (Schanbacher and Ford 1976). This study found varying numbers of spermatogenic cells, and concluded that short scrotum was not as successful at rendering animals infertile as expected. But in this study there were no specific details as to numbers or morphology of cells, the study only drawing limited conclusions.

A separate study by Morcombe et al. (1990) and published in the Australian Veterinary Journal examined all 90 testes histologically and found that all but one testes had bilateral severe degeneration of the tubular epithelium and no spermatogenesis was present. The seminiferous tubular degeneration ranged in severity from complete loss of basal spermatogonia in some, to other where basal spermatogonia were intact and possible primary spermatocytes visible. However no spermatids were present in any tubules. This paper also cited the criteria used by the department of primary industry and energy for approval of methods of sterilizing rams is that <5% of treated rams should be fertile.

A further study found that short scrotum lambs had very low fertility. 50 of 56 lambs had no epididymal sperm reserves and 6 had extremely low sperm production. Almost all sperm found in the 6 lambs with extremely low sperm counts in this study were abnormal (Probert and Davies 1986).

### 4.3 Test mating

Only one study carried out a test mating of short scrotum lambs as a measure of fertility. 11 of the short scrotum lambs with the largest palpable testicles were test mated singly with groups of 20 ewes and the remaining 19 short scrotum lambs were mated with 250 adult ewes. No fetuses were detected on ultrasound 90 days later and no lambs were born to any of the matings (Morcombe et al. 1990).

### 4.4 Semen evaluation

One study (Tierney and Hallford 1985) compared semen characteristics between short scrotum and vasectomised ram lambs using electro ejaculation. Ten, 6 month old ram lambs were short scrotum castrated or vasectomised and then repeated semen samples were taken. The study concluded the short scrotum method was effective in rendering ram lambs sterile by 15 days post procedure. The study found that only 2 of the 10 ram lambs had any detectible sperm at 12 days and, of these small numbers, 95% were abnormal and all but 1% were non-motile. Three of the short scrotum rams regained partial testicular function by 15 months post procedure although motility remained very low.

## 5 Meat quality and taste trials

(Robertson 1965) reviewed evidence from 8 studies using taste panel tests and found that meat from ram lambs was considered to be as flavoursome as or more flavoursome than that from wethers in 6 out of 8 studies. It was also found that, although meat from ram lambs was considered slightly less juicy and tender, the differences were small and were not significant to result in downgrading of the meat (Robertson 1965). In a more recent but similar taste panel study, Anderson (1996) found that meat from grass fed lambs was the most tasty and juicy and that there was no difference in taste between meat from rams lambs and wethers. In support of these conclusions the New Zealand Animal Welfare Advisory Committee in their 'Code of recommendations and minimum standards of welfare of sheep' state that no unpleasant smell and flavouring is present in meat from pre-pubescent ram lambs.

Other anecdotal taste trial results draw varying conclusions and no trial has specifically been undertaken comparing short scrotum meat to either entire's or standard castrates.

## **6 Welfare implications of short scrotum castration**

### **6.1 Behavioural evaluation of acute pain associated with castration**

In short scrotum castration, since the testicles and their innervations are left intact, they should not contribute a source of pain (visceral). This should result in a reduction in the behavioural and physiological responses seen in the first hours after this method of castration when compared with the traditional tight rubber ring method. This method was included as one of the treatments in a study directed at validation of methods for assessment of acute pain in lambs (Molony et al. 2002) and it was found to be significantly less severe than standard castration with tight rubber rings.

A small scale study at FAI Farms further mirrored previous findings, demonstrating significantly less acute pain shown by lambs castrated with the short scrotum procedure, compared to those castrated using the standard tight rubber ring method. Assessment was made observing the lambs' behavioural responses (Clements 2006).

### **6.2 Electrophysiological evaluations of acute pain associated with castration**

(Cottrell and Molony 1995) made electrophysiological recordings of visceral afferent activity in the superior spermatic nerve in lambs in response to the application of rubber rings to the neck of the scrotum. The presence of a ring resulted in 'vigorous discharge' in nociceptors of the testes and pampiniform plexus (a network of veins associated with the testis and epididymus). (Cottrell and Molony 1995) found that nociceptors with afferent fibres in the superior spermatic nerve are not activated by short scrotum castration (where a rubber ring is applied at the neck of the scrotum with the testes proximal to the ring), but they did not measure activity in any of the somatic afferent nerves from the scrotum including the ilioinguinal nerve, caudal scrotal nerve or the scrotal branch of the superficial perineal nerve. As short scrotum castration produces a behavioural response in lambs (Molony et al. 2002), it is likely that stimulation of somatic nociceptors is also important to the overall experience of pain in rubber ring castrated lambs.

In summary since the testes and associated nerves and pampiniform plexus remain intact during short scrotum castration, they are not disrupted, and therefore do not contribute towards the acute pain seen with standard castration. This correlates with the above behavioural responses to pain.

### **6.3 Chronic effects of rubber ring castration**

Much of the quantitative research into the severity of pain resulting from tight rubber ring castration has been focused on determining the severity of acute pain experienced by lambs during the first few hours after application of the rubber ring. However, concerns regarding the chronic effects of the use of rubber rings have also been expressed by researchers in this area.

Within one week after application of the rubber rings, the ischaemic skin immediately proximal to and under the rubber ring begins to break down and an open lesion forms (Barrowman et al. 1953, Kent J.E. et al. 1997, Barrowman et al. 1954, Fenton et al. 1958, Kent et al. 1999, Kent et al. 2000, Molony et al. 1995, Sutherland et al. 2000). These lesions show varying degrees of swelling, inflammation and sepsis and take 6-7 weeks to resolve (Barrowman et al. 1953, Kent J.E. et al. 1997, Barrowman et al. 1954, Fenton et al. 1958, Kent et al. 1999, Kent et al. 2000, Molony et al. 1995, Sutherland et al. 2000). In combination with measurement of the width of the castration lesions, an eleven point scale of lesion severity was developed by (Molony et al. 1995), taking into account swelling, erythema and infection. This scale has been used to follow the changes in lesion severity for six to seven weeks after application of the rings, until complete healing occurs. A gradual increase in lesion severity rises to a peak at around 3-4 weeks after treatment and subsequently gradual healing is observed (Kent J.E. et al. 1997, Kent et al. 1999, Kent et al. 2000, Molony et al. 1995).

No studies have been found directly comparing the potential for chronic pain in short scrotum compared to standard rubber ring castrated lambs, however it has been postulated in the context of castration of older lambs that a reduced amount of tissue within a rubber ring has demonstrated less severe effects.

#### **6.4 Overall Welfare implications**

The welfare implications of these studies are clear. As rubber rings can only legally be applied in the first week of life, the process of gathering and the application of the rings must be carried out at a time when the bond between the ewe and her lambs may not be strongly established. Lambs may be unable to show normal following and suckling after treatment and the chances of miss-mothering are high, particularly in outdoor lambing systems where ewe and lambs are not confined. Young lambs that have been conventionally castrated and suffer pain, may go without suckling for several hours, potentially growing weak. If these procedures are carried out within the first few hours after birth lambs may not suckle sufficient colostrum to gain the benefit of passive immunity. These problems can and do result in increased loss of life (Farm Animal Welfare Council 1994).

The short scrotum method has been demonstrated to result in a reduction in the severity of acute pain compared to standard rubber ring castration and as such represents an improvement which has the potential to reduce the likelihood of negative effects for lambs.

## 7 Conclusions

A substantial amount of research has been carried out documenting potential advantages and differences in growth rates and carcass composition between short scrotum, entire's and wethers. It is clear that potential benefits can be realised if lambs are marketed during the same season

Studies into fertility show varied results and are not sufficient to provide conclusive evidence of infertility to producers at present. Most studies examining fertility have been of systems which castrate lambs at 4-6 weeks of age, as is standard practice in some countries, and thus do not accurately mirror systems in the UK where legal castration is carried out significantly earlier, within 7 days of birth.

Taste trials have demonstrated the acceptability of uncastrated lambs up to puberty and compared to wethers. No trials have included short scrotum lambs or evaluated at what age meat quality might start to be affected by male hormones.

It is clear the standard castration causes significant acute and chronic pain. Some research had compared short scrotum castration to standard rubber ring and found significant reductions in pain responses. The method has the potential to provide a benefit in terms of improved welfare of lambs which can be correlated to improved neonatal survival.

In order that the method might be recommended to farmers some further work is required to evaluate its potential suitability for UK systems and to identify the advantages and disadvantages that its use could bring.

There are 4 specific questions that need to be answered in order to recommend the short scrotum method of castration to UK producers.

1. Can growth benefits be realised at an average plane of nutrition in the UK?
2. Can over-wintered animals perform with comparable advantages?
3. Are lambs rendered infertile using short scrotum castration, if the method is performed within the first 7 days of life?
4. How does short scrotum lamb compare in meat taste trials to entire and standard castrated lamb?

## 8 Thank you.

This study was carried out with funding provided by EBLEX with help from the EBLEX team with aspects of the literature search.



## 9 References

- Anderson, J.M.L., 1996. An evaluation of entire males for lamb production. Unpublished PhD thesis. University of Newcastle upon Tyne.
- Barenton, B., Blanc, M.R., Caraty, A., Hochereau-de Reviere, M.T., Perreau, C., Saumande, J., 1982. Effect of cryptorchidism in the ram: changes in the concentrations of testosterone and estradiol and receptors for LH and FSH in the testis, and its histology. *Molecular and Cellular Endocrinology* 28, 13-25.
- Barrowman, J.R., Boaz, T.G., Towers, K.G., 1954. Castration and docking of lambs: use of the rubber-ring ligature technique at different ages. *Empire Journal of Experimental Agriculture* 22, 189-202.
- Barrowman, J.R., Boaz, T.G., Towers, K.G., 1953. Castration of lambs: comparison of the rubber-ring ligature and crutching techniques. *Empire Journal of Experimental Agriculture* 21, 193-203.
- Clements, R.H., 2006. Comparison of the acute effects on lambs of standard castration and short scrotum castration with tight rubber rings. UFAW scholarship report.
- Cottrell, D.F., Molony, V., 1995. Afferent activity in the superior spermatic nerve of lambs - the effects of application of rubber castration rings. *Veterinary Research Communications* 19, 503-515.
- Cronin, G.M., Dunshea, F.R., Butler, K.L., McCauley, I., Barnett, J.L., Hemsworth, P., 2003. The effects of immuno and surgical castration on the behaviour and consequently growth of group-housed, male finisher pigs. *Applied Animal Behaviour Science* 81, 111-126.
- Farm Animal Welfare Council, 1994. Report on the Welfare of Sheep.
- Fenton, B.K., Elliot J., Campbell R.C., 1958. The effects of different castration methods on the growth and well-being of calves. *The Veterinary Record* 70, 101-102.
- French, N.P., Wall, R., Cripps, P.J., Morgan, K.L., 1992. Prevalence, regional distribution and control of blowfly strike in England and Wales. *The Veterinary Record* 131, 337.
- Glimp, H.A., 1971. Effects of sex alteration, breed, type of rearing and creep feeding on lamb growth. *Journal of Animal Science* 32, 859-862.
- Hopkins, D.L., Gilbert, K.D., Saunders, K.L., 1990. The performance of short scrotum and wether lambs born in winter or spring and run at pasture in northern Tasmania. *Australian Journal of Experimental Agriculture* 30, 165-170.
- Hosie, B.D., Carruthers, J., Sheppard, B.W., 1996. Bloodless castration of lambs: results of a questionnaire. *British Veterinary Journal* 152, 47-55.
- Kent J.E., Molony, V., Hosie, B.D., Sheppard, B.W., 1997. Assessment of chronic inflammatory pain after rubber ring castration of six week old lambs. *Proceedings of the Sheep Veterinary Society* P21, 93.
- Kent, J.E., Jackson, R.E., Molony, V., Hosie, B.D., 2000. Effects of acute pain reduction methods on the chronic inflammatory lesions and behaviour of lambs castrated and tail docked with rubber rings at less than two days of age. *The Veterinary Record* 160, 33-41.
- Kent, J.E., Molony, V., Jackson, R.E., Hosie, B.D., 1999. Chronic inflammatory responses of lambs to

rubber ring castration are there any effects of age or size of lamb at treatment., in: Russell, A.J.F., Morgan, C.A., Savory, C.J., Appleby, M.A., Lawrence, T.L.J. (Eds.). British Society of Animal Science., pp. 160-162.

Lester, S.J., Mellor, D.J., Ward, R.N., Holmes, R.J., 1991. Cortisol responses of young lambs to castration and tailing using different methods. *New Zealand Veterinary Journal* 39, 134-138.

LeValley, S.B., DeWalt, M.S., Huffhines, C.P., Tatum, J.D., Smith, G.C., 1994. Comparison of short-scrotum and wether lambs for growth and carcass characteristics. *Sheep Research Journal* 10.

Mellor, D.J., Murray, L., 1989. Effects of tail docking and castration on behavior and plasma- cortisol concentrations in young lambs. *Research in Veterinary Science* 46, 387-391.

Ministry of Agriculture and Fisheries (NZ), 1996. Codes of Recommendations and Minimum Standards for the Welfare of Sheep. Animal Welfare Advisory Committee, Ministry of Agriculture, Wellington, New Zealand.

Molony, V., Kent, J.E., Robertson, I.S., 1995. Assessment of acute and chronic pain after different methods of castration of calves. *Applied Animal Behaviour Science* 46, 33-48.

Molony, V., Kent, J.E., McKendrick, I.J., 2002. Validation of a method for assessment of an acute pain in lambs. *Applied Animal Behaviour Science* 76, 215-238.

Morcombe, P.W., Peet, R.L., Bell, S.J., 1990. The sterility and productivity of young, short scrotum, Merino rams. *Australian Veterinary Journal* 67, 235-236.

Price, E.O., Adams, T.E., Huxsoll, C.C., Borgwardt, R.E., 2003. Aggressive behavior is reduced in bulls actively immunized against gonadotropin-releasing hormone. *Journal of Animal Science* 81, 411-415.

Probert, A.D., Davies, A.S., 1986. A study of short scrotum, castrated and entire ram lambs. *New Zealand Society of Animal Production* 46, 55-58.

Robertson, I.S., 1965. Castration in farm animals: its advantages and disadvantages. *The British Veterinary Association* .

Schanbacher, B.D., Crouse, J.D., Ferrell, C.L., 1980. Testosterone influences on growth, performance, carcass characteristics and composition of young market lambs. *Journal of Animal Science* 51, 685-691.

Schanbacher, B.D., Ford, J.J., 1976. Lutenizing hormone, testosterone, growth and carcass responses to sexual alteration in the ram. *Journal of Animal Science* 43, 638-643.

Sutherland, M.A., Stafford, K.J., Mellor, D.J., Gregory, N.G., Bruce, R.A., Ward, R.N., 2000. Acute cortisol responses and wound healing in lambs after ring castration plus docking with or without application of a castration clamp to the scrotum. *Australian Veterinary Journal* 78, 402-405.

Tierney, L.A., Hallford, D.M., 1985. Mating behaviour, serum testosterone and semen characteristics. *Theriogenology* 23, 535-545.

Wellington, G.H., Hogue, D.E., Foote, R.H., 2003. Growth, carcass characteristics and androgen concentrations of gonad-altered ram lambs. *Small ruminant research* 48, 51-59.

Wood, G.N., Molony, V., Fleetwood-Walker, S.M., Hodgson, J.C., Mellor, D.J., 1991. Effects of local-

anesthesia and intravenous naloxone on the changes in behavior and plasma-concentrations of cortisol produced by castration and tail docking with tight rubber rings in young lambs. *Research in Veterinary Science* 51, 193-199.