

# BEHAVIOURAL RESPONSES TO CASTRATION IN LAMBS

P D Thornton and A E Waterman-Pearson

Department of Clinical Veterinary Science, University of Bristol, Langford,  
Bristol, BS40 5DU, UK

## Abstract

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*We examined the effects of two different methods of castration on the behaviour of lambs of two age groups. Rubber ring castration and combined rubber ring and Burdizzo clamp castration were compared in groups of one-week-old lambs and four- to six-week-old lambs. Behaviour was assessed by examining time-lapse video recordings made continuously over four days. Postures and behavioural states were instantaneously sampled and the mean daily frequencies of these behaviours calculated. Behaviours were assigned to different groups: standing still, moving, eating, lying, playing and abnormal postures. The times spent performing each group of behaviours on the days following castration (days 2, 3 and 4) were compared to those on the day preceding castration (day 1). Castration resulted in significant reductions in the times spent performing play behaviour in one-week-old lambs and lying behaviour in four- to six-week-old lambs. There was also a significant increase in abnormal postures following castration in four- to six-week-old lambs. There were no detectable differences between castration methods. The results show that lambs exhibit changes in behaviour over the three-day observation period that are suggestive of the presence of prolonged acute pain. These results have important implications regarding the sheep welfare recommendations of the Farm Animal Welfare Council, which propose to extend the maximum legal age for rubber ring castration from one week to six weeks of age.*

**Keywords:** *animal welfare, behaviour, castration, lambs, pain, time-lapse video recording*

## Introduction

Castration is a commonly used management tool in modern sheep husbandry. Although the requirement for specific carcass characteristics and the way in which lambs are produced have changed, leading to a decrease in the number of lambs castrated, the number of lambs undergoing castration remains high (Vipond & Hosie 1997). Different methods of castration are available and they are controlled by the Protection of Animals Act 1954 and the Veterinary Surgeons Act 1966. Rubber ring elastration and other methods of castration that interrupt the blood supply to the testes may only be performed by 'competent persons' on lambs during the first week of life. Surgery or 'open' castration may be performed by 'competent' persons on lambs up to three months of age. Castration carried out in these ways may be performed without anaesthesia or analgesia. However, after three months of age, surgical castration only may be performed using anaesthesia and by a veterinary surgeon.

Since the mid-eighties, there have been numerous studies attempting to quantify the pain and distress experienced by lambs following castration. The effects of different methods of castration have been examined using a range of different measurements. Ways of assessing the pain resulting from castration and tail-docking include measuring plasma concentrations of cortisol (Shutt *et al* 1987; Mellor & Murray 1989; Mellor *et al* 1991; Lester *et al* 1991; Dinnis *et al* 1997) and observing behaviour. Behavioural observations following castration

include measuring frequencies of event behaviours, such as foot stamping and kicking (Molony *et al* 1993; Kent *et al* 1995; Lester *et al* 1996), and measuring durations of behavioural states, such as abnormal lying postures — for example, lateral lying with the hind limbs extended (Mellor & Murray 1989; Mellor *et al* 1991; Molony *et al* 1993). There appears to be some controversy as to the reliability of the methods available for behavioural assessment. Factors such as the substantial animal-to-animal variation in the behaviours displayed, the limited number of behaviours that have been recorded, and the presence of false-positive observations in control lambs all contribute to this unreliability (Lester *et al* 1996). Thus, there is a need for further behavioural studies to reconcile these shortfalls. In addition, all of the studies discussed above have measured behavioural responses in the first three to eight hours following castration. Further work is required to determine if there are any changes occurring over a longer period of time, as any welfare issue must be judged upon the duration of the negative welfare state as well as its intensity and the number of animals affected. Furthermore, there is the possibility that more subtle changes in behaviour may occur, and/or that the response of the lamb to observer intervention overwhelms any changes in behaviour or other parameter that it may be exhibiting (Sherwin 1993). In order to address these points, it was decided that behaviour would be measured using time-lapse video recording over a period of three days following castration.

Lambs of four to six weeks of age are examined in this study. This is because in hill flocks lambing outside, the normal practice is to handle the lambs as little as possible during the first weeks of life. Gathering ewes and lambs at this stage is undesirable, as the chances of mismothering and consequential lamb deaths are high. By four to six weeks of age, however, lambs are considered to be strong enough and the bonding firm enough to tolerate various procedures including gathering, castration and tailing. It is well known that many hill farmers prefer to castrate using rubber rings but are unable to use them legally on these older lambs. Studies so far do not provide evidence that castrating lambs at this older age is any worse for them than castrating them at one week of age (Kent *et al* 1993; Molony *et al* 1993). With this in mind, FAWC has recommended that farmers be allowed to castrate lambs up to six weeks of age using rubber rings. In addition, FAWC recommend that further investigations be made to compare the response to castration at four to six weeks of age to that at one week of age (FAWC 1994).

The most widely used method of castration is rubber ring elastration. A refinement of this method is the combination of the rubber ring with the Burdizzo clamp (Molony *et al* 1993; Kent *et al* 1995). This combined method involves applying the clamp over the entire neck of the scrotum following application of the rubber ring in the conventional way. Using the clamp alone in the conventional way (by clamping each spermatic cord separately twice proximal to the testes) can be difficult because of the small size of the cord and scrotum in relation to the clamp. A recent study has shown low compliance (12%) in adhering to operating instructions when the clamp is used alone (Hosie 1996). The combined use of the clamp with the ring should theoretically reduce the failure rate compared to using the clamp alone. This combined technique, compared to using rubber rings alone, has been shown to reduce active pain avoidance behaviours and the rise in plasma cortisol associated with pain and distress (Kent *et al* 1993; Kent *et al* 1995). However, the pain and distress measurements used in these previous studies have been made over the first three hours following castration. It is conceivable that over the three days following castration, any advantage of combining the rubber ring with the clamp may no longer be manifest. Thus, in this study, the rubber ring method of castration was compared with the combined rubber ring and clamp method.

The aims of the present study were:

- 1) To establish the postures and behavioural states exhibited by lambs of one week and four to six weeks of age under normal circumstances (ie not in pain or distress), and to ascertain the duration for which these behaviours are exhibited;
- 2) To test whether there is evidence for prolonged acute pain (by observing which behaviours, if any, are modified following each method of castration);
- 3) To test whether different age groups respond differently;
- 4) To test whether there are differences in the effect of each castration method.

To address the potential confounding effect caused by the observer, behaviour was measured using time-lapse video recording. This study was licensed by the Home Office under the Animals (Scientific Procedures) Act 1986.

### Materials and methods

Lambs due to be castrated were recruited from local farms. They were transported to the study centre with their dams using a standard trailer. All lambs were checked for signs of ill health prior to transport. Any lambs showing signs of ill health at this stage were not used. Transport times did not exceed 30 min and the minimum age of the lambs when transported was two days. On arrival, the animals were allowed to acclimatise for a period of not less than 24 h. Once at the investigation centre, the lambs were checked again and excluded from the study if not clinically fit. Any lambs with undescended testes were also not used. Lambs that were to be used at four to six weeks of age were kept in groups with their dams until required. These lambs were treated with a coccidiostatic agent (sulphamethoxypyridazine) at three weeks of age.

During recording, dams with single lambs were housed indoors in a pen measuring 1.8 x 1.8 m. A straw bed was provided, and the animals had access to hay and water *ad libitum* and were fed concentrates at the rate of 500 g per ewe per day divided into two rations. Temperature was not controlled and remained at ambient levels throughout the time that the animals were housed. Each ewe was in visual, olfactory and auditory contact with other ewes within the same building so as to reduce stress caused by isolation. The camera (Panasonic WV-BP310 with Panasonic auto iris WV-LA4R5C3A 4.5 mm lens) was placed above the pen at an angle of about 45° so that the entire pen was in view and there was minimal chance of the ewe obscuring the lamb from view. This angle permitted distinction between standing and lying postures. An infrared lamp allowed recording throughout the night. The camera was connected to a Mitsubishi HS5424 time-lapse video recorder set to record 27 h on a three-hour tape.

Five groups of lambs were used:

- 1) One-week-old lambs handled only (controls) (n = 6);
- 2) One-week-old lambs castrated using rubber rings (n = 6);
- 3) One-week-old lambs castrated using the combined rubber ring and Burdizzo clamp method (n = 6);
- 4) Four- to six-week-old lambs castrated using rubber rings (n = 6);
- 5) Four- to six-week-old lambs castrated using the combined rubber ring and Burdizzo clamp method (n = 6).

**Group 1 — Sham castration**

Lambs were handled as if being castrated using the rubber ring or combined method. The lambs were held in dorsal recumbency supported by the knee of the person holding the animal. The person castrating the lamb (PDT) then palpated the scrotum to check for the presence of testes. The neck of the scrotum was then firmly held as if about to place a rubber ring. The lambs were then released. This group of lambs was included in the study to test whether gambolling behaviour decreased during the days following castration because of the castration procedure or because lambs of this age tend to perform decreasing amounts of this behaviour with time. Because four- to six-week-old lambs exhibit very low levels of gambolling behaviour, if any, there was no need to have a control group for this age of animal.

**Groups 2 and 4 — Rubber ring castration**

Lambs were held as for sham castration. The testes were held within the scrotum by one hand. A rubber ring was then applied over the neck of the scrotum using an elastrator so that both testes were held distal to the ring in the scrotum and the mamillae remained proximal to the ring.

**Groups 3 and 5 — Combined rubber ring and Burdizzo clamp castration**

Lambs were held and castrated as for rubber ring castration. Immediately after the placement of the ring, a Burdizzo clamp was applied across the entire width of the scrotal neck just distal to the ring. The clamp was shut and the underlying tissues (including the spermatic cords) were crushed for ten seconds. This method has been described previously (Molony *et al* 1993; Kent *et al* 1995). The Burdizzo clamp was the 'Baby' model and had a jaw width of 40 mm and handle length of 120 mm.

**General protocol**

Animals were allowed to acclimatise to the pen for at least 24 h before the start of recording. On the first day (ie the 24 h before castration), a baseline of behaviours and their duration was established. Castration or handling only was performed at 0900h on the second day. Time-lapse recording was at the rate of three frames per second. The recorded material was examined by instantaneous sampling every 10 min. At each scan point, the behavioural state (postures and long-term activities) was noted (see Table 1).

**Treatment of results and statistical analysis**

For each lamb, daily totals for each behavioural state or posture were calculated. Behaviours were then grouped in the following five categories: moving, eating, standing, lying, and abnormal postures (see Table 1). The groups were formed on the basis that they represent major categories of behaviours, which may be affected by the presence of pain. The 'abnormal postures' group contains postures described in previous studies as mostly occurring when a lamb is in pain following castration (Mellor & Murray 1989; Molony *et al* 1993). Within the 'moving' category, changes in the frequency of gambolling were investigated. This is because previous studies of the effects of prolonged pain following castration in lambs looked at 'play' behaviour as an indicator of the presence of pain (Kent *et al* 1997).

**Table 1** List of all the behavioural states and postures exhibited by the lambs and recorded using instantaneous sampling. The list is sub-divided into broad categories, within which behavioural states and postures are grouped into 'classes' of behaviour.

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<b><i>Moving behaviour</i></b>
Standing walking forwards, standing gambolling
<b><i>Eating behaviour</i></b>
Standing foraging, standing sucking, lying ventrally foraging
<b><i>Standing behaviour</i></b>
Standing resting, standing scratching, standing ruminating
<b><i>Lying behaviour</i></b>
Lying ventrally resting, lying ventrally resting FE, lying ventrally sleeping, lying ventrally sleeping FE, lying ventrally ruminating, lying ventrally ruminating FE, lying ventrally scratching, lying laterally resting, lying laterally resting FE, lying laterally sleeping, lying laterally sleeping FE
<b><i>Abnormal behaviour</i></b>
Standing walking backwards, standing kneeling, standing stretched/hunched, lying ventrally resting HE, lying ventrally resting BE, lying ventrally sleeping HE, lying ventrally sleeping BE, lying ventrally ruminating HE, lying laterally resting HE, lying laterally resting BE, lying laterally sleeping HE, lying laterally sleeping BE, "dog sitting"

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FE, front limb(s) extended; HE, hind limb(s) extended; BE, both fore and hind limbs extended.

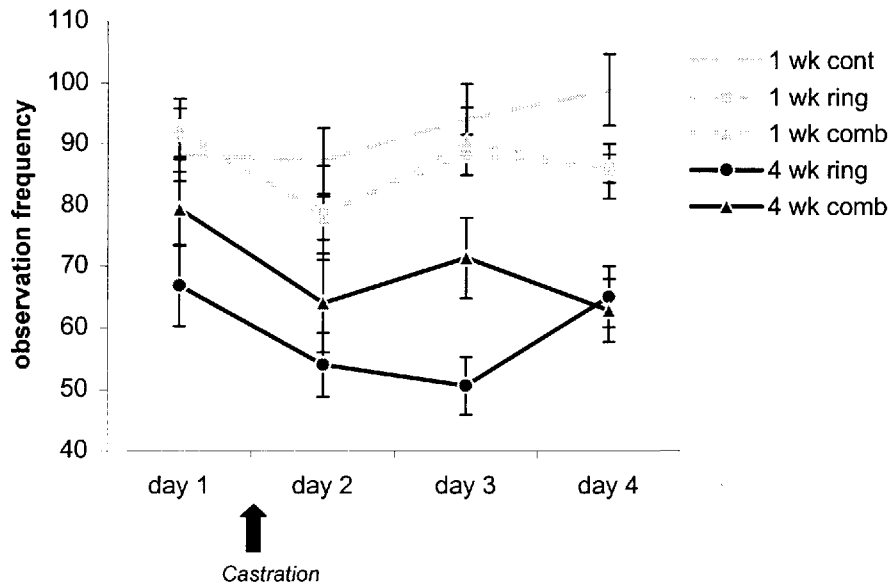
Residuals were checked for normality. Groups of lambs (by castration method) were then tested for differences, with age, treatment and days as factors, using PROC GLM in SAS with repeated measures (SAS 1988). Groups were first tested for homogeneity on day one (before castration), and the data were discarded if there were significant differences between treatment groups on day one. The data were retained if any differences on day one were attributable only to age. Furthermore, the control group of lambs was tested separately in order to identify changes in behaviour occurring over time during the first week or so of life. Such changes were considered less likely to occur in the older age group, hence the absence of a control group for the older lambs.

## Results

Time-lapse video recording was found to be a convenient and useful method of observing lambs. Although the camera view took in the entire pen so that the lamb was almost always in sight, the ewe occasionally obscured the lamb. This happened on such random occasions that it was entered merely as a missing data point when the tapes were analysed. Four tapes contained less than 100 observations out of a maximum of 144 for one day because of a mechanical failure; these tapes were not analysed. Although auditory disturbances could not be eliminated completely, the experiments were performed in an isolated building accessed only by the author (PDT) and the animal care technician. The effect of infrared light is unknown, as few studies have investigated whether this form of light influences behaviour (Sherwin 1993). Infrared light did not appear to have any effect in this study.

Castration resulted in significantly less time spent lying down (Figure 1) ( $F_{3,82} = 8.19$ ;  $P = 0.0002$ ) and a significant increase in the time spent performing abnormal postures (Figure 2) in four- to six-week-old lambs ( $F_{3,82} = 9.21$ ;  $P = 0.0001$ ). As expected, one-week-old lambs gambolled significantly more than the four- to six-week-old lambs ( $F_{1,82} = 12.28$ ;  $P = 0.0025$ ), and castration significantly reduced the time spent gambolling by one-week-old lambs (Figure 3) ( $F_{3,82} = 3.14$ ;  $P = 0.033$ ). Although the method of castration gave rise to no significant differences in the behaviours observed, combining the ring with the clamp decreased the effect that ring castration alone had on lying behaviour and abnormal postures in the four- to six-week-old lambs. Likewise, although there were no significant differences

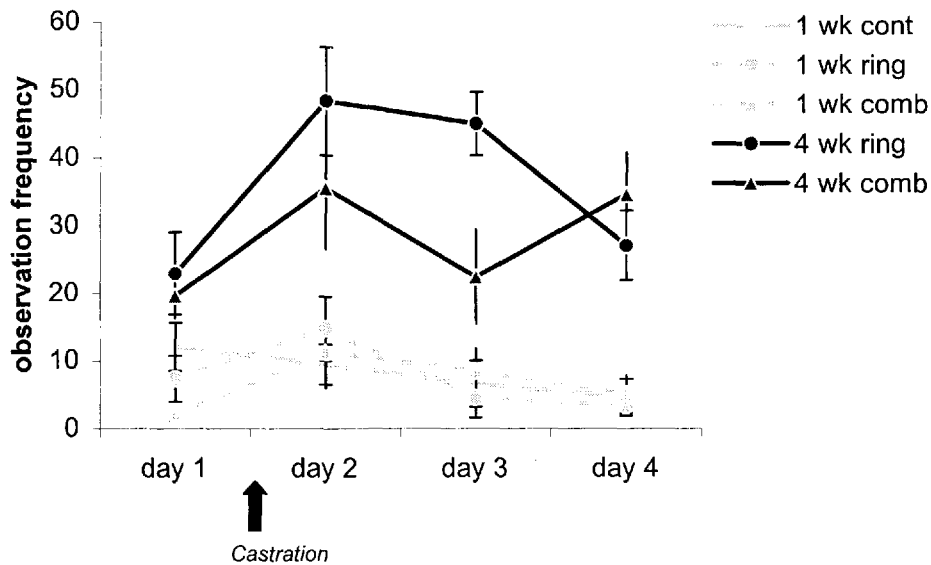
between castration methods in the effect on gambolling, combining the ring and the clamp reduced the effect that ring castration had on this behaviour.



**Figure 1** Daily observation frequencies (mean  $\pm$  SEM) for lying postures in one-week-old and four- to six-week-old lambs. Lambs were castrated at the start of day two. Castration resulted in significantly ( $P=0.0002$ ) reduced frequency of lying in the older lambs. Comb, combined group; cont, control group.

### Discussion

The aim of this study was to determine whether castration resulted in any changes in behaviour during the three days following the procedure, and whether there were any effects of age and castration method on these behavioural changes. There are few other reports of prolonged pain in farm species following castration. In a study examining the chronic effects of castration by several methods in one-week-old calves, several behaviours were measured: posture, eating, playing, and ruminating (Molony *et al* 1995). Animals were assessed by direct observation continuously for three hours at a time, every three days for 48 days. Attempts were made to correlate changes in behaviour with the size and severity of the castration lesion. There were no statistically significant differences in the duration of abnormal standing postures or in play behaviour between castrated animals and animals handled only (controls). Furthermore, there were no differences in lateral lying postures between control and castrated animals; this behaviour was previously found to be useful for assessing acute castration pain (Mellor & Murray 1989; Mellor *et al* 1991; Molony *et al* 1993). It was suggested that the lack of any significant differences in calves' behaviour following castration could be attributable to the 'waxing and waning nature' of the pain experienced. There was also a further suggestion that 'chronic' pain behaviours are less likely to be exhibited by predated species such as the calf.



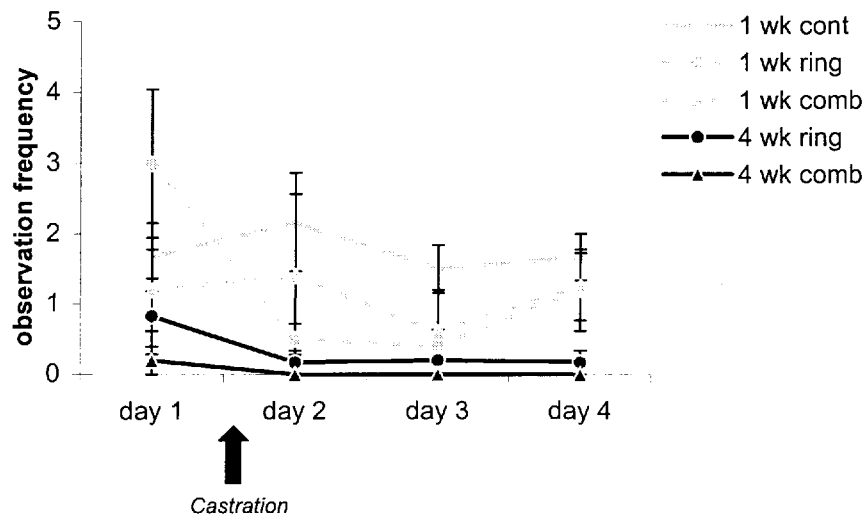
**Figure 2** Daily observation frequencies (mean  $\pm$  SEM) for abnormal behavioural states and postures in one-week-old and four- to six-week-old lambs. Lambs were castrated at the start of day two. Castration resulted in a significant ( $P = 0.0001$ ) increase in the frequency of abnormal postures in four- to six-week-old lambs. Comb, combined group; cont, control group.

The results show that some behaviours considered normal in the lamb are reduced following castration. These include gambolling in one-week-old castrated lambs and lying in four- to six-week-old castrated lambs. So-called abnormal postures, such as lying ventrally or laterally with one or both hind limbs extended (Mellor & Murray 1989; Lester *et al* 1996), were seen before castration, suggesting that lambs will adopt these postures when not in pain. The adoption of these postures by control lambs has been reported previously (Lester *et al* 1996). However, despite this, the four- to six-week-old lambs showed a significant increase in abnormal postures following castration. There were no differences between castration method in the resulting postural changes.

The results also suggest that there are changes in behaviour that indicate a degree of pain or discomfort in the four- to six-week-old lambs in the three days following castration. There was a decrease in gambolling following castration in one-week-old lambs with no significant differences between castration methods. Even before castration, the older lambs rarely exhibited gambolling; thus, it would be difficult to show a reduction in this behaviour following castration.

Hosie (1996) examined the chronic effects of rubber ring and Burdizzo clamp castration in five- to six-week-old lambs pre-treated with local anaesthetic. The study, however, only examined the size and severity of the castration wound and, from this, made inferences as to the degree of pain that the lambs might be experiencing. No attempt was made to measure behaviour. It was concluded that the chronic effects of castration were mild and did not compromise the health or growth rate of the animals. However, Kent *et al* (1997) examined

both the lesion and behaviour of six-week-old lambs for seven weeks following rubber ring castration. Lambs were observed for active pain behaviours and postures for six hours once per week. Lambs showed significant increases in active pain behaviours (foot stamping and kicking, 'easing quarters', and rubbing the quarters) compared to controls. The peak incidence of these behaviours coincided with the maximum lesion size and severity (14–28 days following castration). However, there was no effect on the incidence of play behaviour (as invoked by the introduction of boxes to play on) or on eating.



**Figure 3** Daily observation frequencies (mean  $\pm$  SEM) for gambolling in one-week-old and four- to six-week-old lambs. Lambs were castrated at the start of day two. There was a significant decrease ( $P = 0.036$ ) in gambolling behaviour following castration in one-week-old lambs. There were no differences between castration method. Comb, combined group; cont, control group.

The results presented here show that abnormal postures (including lateral lying with hind limbs extended) are increased for the three days of observation following castration in four- to six-week-old lambs. Furthermore, play behaviour (gambolling) was significantly reduced following both methods of castration in one-week-old lambs. If an animal is experiencing primary hypersensitivity at the wound site, one might expect there to be some changes in whole-body behaviour to reflect this. It has been demonstrated that the scrotum is as sensitive to palpation on the three days after rubber ring or combined castration as on the day of castration (Thornton & Waterman-Pearson 1999; Thornton 1999). It is likely that scrotal pain is responsible for the observed decrease in gambolling, as excessive movement may exacerbate it. Equally, abnormal lying postures may be a way of reducing the scrotal pain in the four- to six-week-old lambs. In short, this study has demonstrated that castration, by either the rubber ring method or the combined ring and clamp method, produces a behavioural response indicating that lambs of either age group are suffering from prolonged pain.



The increase in abnormal postures seen in the four- to six-week-old lambs is particularly relevant to the FAWC report on the welfare of sheep (FAWC 1994). The report recommends that rubber ring castration be legalised for lambs up to six weeks of age because “we are aware of evidence, which indicates that castration with rubber rings causes similar distress with older lambs up to six weeks”. It is clear from the evidence presented here that this older age group of lambs experiences a degree of pain or discomfort for the three days following castration. The legislative authorities must be cautious when responding to the demands of the industry and take such evidence into account before embarking on changing the law.

In conclusion, the results presented here show that there are changes in the behaviour of one-week-old lambs indicating the presence of a degree of prolonged acute pain: they gambolled less following castration. In four- to six-week-old lambs, castration increased the frequency of abnormal postures and reduced normal lying behaviours, which also indicates the presence of prolonged acute pain. Therefore, it is clear that castration affects behaviour for longer than just two to three hours on the day of castration. Further work using the technique of time-lapse video recording over a longer period of time is required to assess whether the changes seen over the three days following castration persist for longer — perhaps weeks.

The issue of extending the legal age limit for rubber ring castration is somewhat contentious. Although it may be preferable to use rubber rings in place of surgical castration without anaesthesia or analgesia, it is important to take account of the scientific evidence. Such evidence suggests that lambs in the older age group exhibit as much pain as the one-week-old lambs. However, because this is reflected in changes in different behaviours, it is difficult to judge whether the decrease in gambolling (seen in one-week-old lambs) indicates more or less pain than the increase in abnormal postures (seen in four- to six-week-old lambs).

#### *Animal welfare implications*

The most important finding is that lambs of both one week and four to six weeks of age show behavioural signs of prolonged acute pain following both methods of castration. These findings must be taken into account when we evaluate the welfare consequences of castrating lambs given that any change in welfare state of a group of animals is dependent upon the magnitude, duration and number of animals. If castration must be performed (and there are many instances in which it is not necessary), then the use of the combined method will still be preferable — despite the lack of significant differences between castration methods in this study — because it is well-established that combining the clamp with the ring drastically reduces the pain response in the first three hours compared to using the ring alone. Furthermore, the results of this study have important implications regarding the recommendation of FAWC to extend the legal use of the rubber ring in lambs from one week to six weeks of age.

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