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The use of skin grafts in the management of dehorning complications in West African Dwarf Bucks

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Target Audience: Veterinarians and Farm animal handlers

Abstract

Four West African Dwarf (WAD) bucks were presented with overgrown horns at Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta. Dehorning was performed using standard surgical procedure. Fourteen days post-surgery, autogenous-skin graft was performed on the bucks when they had closure failure of the frontal sinuses following dehorning. Standard surgical and anaesthetic techniques were adopted in harvesting circular (2cm in diameter) full-thickness skin grafts from both sides of the abdomen of the bucks; grafts were made on the recipient beds after debriding the excess granulation tissue. Complete inosculation of the vessels and healing was observed on the grafts by fourteenth day post-grafting. The surgical wound of the donor sites healed without complications. Tension–releasing-incision was suggested as an alternative to autogenous-grafting in other to minimize post-surgical complications associated with double surgery in autogenous-skin grafting and the anaesthetic risks of the patients. Disbudding at early stage of life in bucks prone to in-growing horns is recommended to animal owners as a management practice to avoid horn overgrowth at older stage.

Keywords: Skin Grafts; Dehorning; Complications; WAD Bucks

Description of the Problem

Horns are bony outgrowths/ pointed projection on the head of various hoofed mammals such as rhinoceroses, deer, giraffes, goats, and cattle (1). They are special adaptations of the integument. The corium (the area of cells located at the junction of the horn and skin) is the site of horn production (2). The horns of goats grow caudally over the skull (3). They serve chiefly as weapons of defense or attack, fighting members of their own species for territory, dominance or mating priority, feeding and cooling (3). All horns have in common an essential substance called keratin, a fibrous protein produced in the outer layer of skin; keratin is also a

component of beaks, hair, nails, hooves, scales, shells, claws and feathers.

Horns begin as buds within the skin of the poll. At approximately two months of age, the horn buds become attached to the periosteum of the frontal bone overlying the frontal sinus. As the horns grow, the cornual diverticulum of the caudal diverticulum of the caudal portion of the frontal sinus extends into the most proximal portion of the horn (4). The entire frontal sinus is lined by mucous membrane (5).

The cornual nerve, a branch of the Trigeminal nerve (cranial nerve V), provides sensation to the skin of the horn/horn bud region. Injection of a local anaesthetic around the cornual nerve as it transverses the frontal crest desensitizes the area (2).

In several cases, overgrown horns may pose a threat to the animal itself, danger to handlers and some risk of interference from dominant animals that may bully other animals on the farm (6). These necessitate the removal of the horns after they have formed from the horn bud. Dehorning is also done for cosmetics purposes and most importantly to improve the productivity of such animals. In most cases dehorning is associated with severe pain and therefore necessitates desensitization (7).

In-growing horn can be defined as inward growing of the horn toward the body (**8)**. This growth can be toward the skull or eye. The growth of horn toward the skull can lead to the penetration of the horn through the skull to the brain thereby causing a fracture to the skull and damage to the brain which can be detrimental to the health of the animal (1). If the horns grow toward the eye, it can traumatize the eye. The diagnosis of this condition is by physical examination of the horn and detection of the horn's growth toward the skull or eye. The management of an in-growing horn is by dehorning. Physical methods of dehorning include the use of embryotomy wire, dehorning knife or saw and electric bone cutter (1). The presence of the cornual diverticulum of the frontal sinus makes surgical dehorning of adult ruminant to be more invasive (4). Dehorning of adult ruminant is associated with increased risks of sinusitis, bleeding, prolonged wound healing and infection (9).

Sedation using xylazine had a minor effect on the cortisol response following dehorning (7). However, *(7)* showed that this response was virtually eliminated when xylazine was combined with the administration of lignocaine hydrochloride as local anaesthetic. They found out that dehorning stimulated a defined cortisol response with a rapid rise to a peak value within 30 minutes followed by a decline to a plateau which then declined to pre-treatment values after about 8 hours. A cornual nerve block using lignocaine hydrochloride virtually eliminated the behaviour seen during dehorning and reduced the plasma cortisol response to dehorning for about 2 hours.

Avoidance behaviours observed during dehorning includes tail wagging, head movement, tripping, and rearing (10). Postoperative indicators of pain include head rubbings, head shaking, neck extension, ear flicking, increased numbers of transitions between lying and rising and reduced rumination (10,

11).

A skin graft is a section of epidermis and dermis which has been completely separated from its blood supply in one part of the body (donor site), before being transplanted to another area of the body (recipient site) (12). It is commonly used to close defects unable to be closed with the simple apposition of wound edges (13). Skin grafts can be classified based on how much of the dermis is harvested by the surgeon (thickness) into split-skin grafts and full-thickness grafts (14).

For a skin graft to adhere successfully to the wound bed, two conditions must be satisfied; first, the wound bed should be clean and free from necrotic or slough tissue which would be heavily colonized with bacteria. Secondly, it must be held in close proximity to the wound bed and immobilized. This can be achieved by suturing the graft in place, then using a firm dressing to ensure that shearing does not occur (15).

Soon after application of the skin graft, a fibrin network is produced which acts as a biological glue and adheres the graft to the wound bed. This network is then infiltrated by fibroblasts, leucocytes and phagocyte cells from the wound bed, and is converted into a fibrous tissue attachment between the skin graft and the wound bed. There are several vessels within the skin graft which dilate and capillary action draws this serous fluid into them to provide nutrients for the graft tissues. This process is known as plasmatic (serous) imbibitions (15). Inosculation occurs when the blood vessels in the skin graft anastomose or unite with the ends of vessels of approximately the same diameter in the wound bed. This occurs between 48–72 hours after application of the graft. The fibrin network acts as a supportive frame along which endothelial buds from blood vessels in the wound bed grow to meet the blood vessels in the skin graft (15). Blood flows through the anastomoses into the graft vessels on day 3 to 4 and is sluggish until day 5 to 6 (16). Once this is established the skin graft gradually takes on colour and becomes red-purple. The skin graft begins to develop its own system of blood vessels and lymphatic vessels (17). As the graft continues to mature in its new site, it regains partial sensation from the sensory nerves of the wound bed. This is thought to be due to the thickness of the skin graft (18). Scar contracture happens gradually over the following 6 to12 months and the thicker the graft, the less contracture occurs (18). The objectives of this study are to evaluate the surgical dehorning in WAD bucks and assess the use of skin grafts in the management of dehorning complications in WAD bucks.

Materials and Methods

Experimental animals: Four male WAD bucks of about 18 months of age, weighing between 16 and 20kg were presented with abnormalities in the growth of the horns.

Clinical Examination: Clinical Examination revealed a mean rectal temperature of $38.8 \pm 0.2\ ^{0}C$, heart rate of 80 ± 0.4 beats per minute and pulse rate of 75 ± 0.2 beats per minute. Physical examination revealed normal gait, a pinkish ocular mucous membrane, normal lymph nodes and absence of tick

infestation or other ecto-parasites. The direction of the growth of the two horns in the goats were caudo-ventral and already touching the skull in all the four bucks (Figure 1). A confirmatory diagnosis of in-growing horn was made.

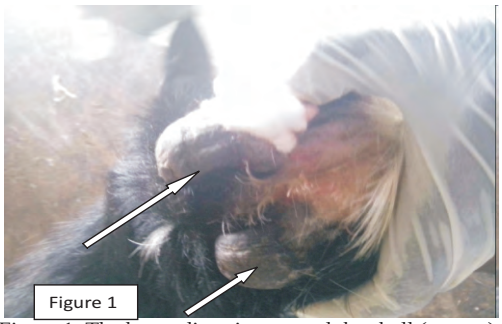


Figure 1: The horns direction toward the skull (arrows)

Management plan: Dehorning of the bucks from the base of the horn using a gigli wire to prevent further growth into the skull was performed. Briefly, each buck was restrained by xylazine sedation at the rate of 0.05mg/kg intramuscularly and fluid was infused at a maintenance dose of 50ml/kg/day (19) through the jugular vein using an 18 gauge cannula. The local block was achieved by infiltrating 3ml of 2% lidocaine hydrochloride around the base of each horn. Each of the bucks was placed on sternal recumbency. The surgical site at the base of the horns was clipped and scrubbed with chlorhexidine, while the skin around the base of the horn was incised and the underlying tissues and skin around the base of the horn were undermined. The periosteum of the frontal bone was exposed and the horn was cut from the base using a gigli wire. A gauze bandage was then inserted into the frontal sinus after cutting off the horn (Figure 2).The two edges of the skin flap were brought together in close apposition over the horn bud and then sutured with a nylon suture material using simple interrupted suture pattern. The same procedure was repeated with the horns.

Figure 2: Gauze bandage in the frontal sinus (arrow)

Post-operative management: Penicillin-streptomycin, at 20,000 IU/20mg per kg was administered for the first five days through the intramuscular route and another 1ml of the drug was infused into each of the surgical sites. The bucks were isolated from other goats, while their movement were restricted and food and water supplied *ad libitum*.

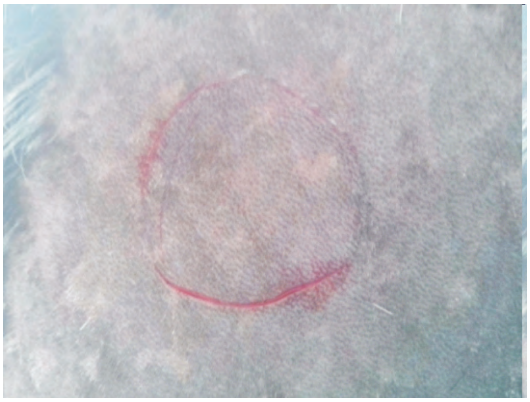
Complications: Two weeks after the *operation*, it was discovered that the skin did not appose. The skin had healed up round the horn bud leaving the frontal sinuses opened. The bucks were active, alert and there was no sign of infection of the skin that surrounded the horn buds. Blood samples were collected to review the animals (Table 1). The bucks were scheduled for skin grafting to cover up the frontal sinuses. The choice of treatment for this complication is skin graft. Patient evaluation was carried out in preparation for skin graft. The result reveals fitness for skin graft.

Second Clinical Examination: The second clinical examination revealed a rectal temperature of 38.5 ± 0.2^{0}C, heart rate of 74.0 ± 0.3 beats per minute, pulse rate of 73.0 ± 0.2 beats per minute and a respiratory rate of 20.0 ± 0.2 breaths per minute. Physical examination revealed a pinkish ocular mucous membrane, no tick infestation and normal lymph nodes in all four.

Patient preparation for skin grafting: The hairs around the base of the two horns in each goat were clipped and scrubbed with chlorhexidine, after which the right and left lateral abdomen was clipped and scrubbed with chlorhexidine. Xylazine was administered at the rate of 0.05 mg/kg through the intramuscular route to sedate the bucks. Intubation was achieved with size 7.0-8.5ID endotracheal tubes while 2 ml of 2% lidocaine hydrochloride was infiltrated around each of the horn buds. Flunixin meglumine was administered intramuscularly at the rate of 2 mg/kg to achieve analgesic and anti-inflammatory actions. Normal saline was infused through the jugular vein at the rate 50ml/kg/day. The bucks were placed on sternal recumbency.

Surgical procedure: The healed skin around the horn bud was debrided, the gauze bandage in the frontal sinuses were removed and normal saline was then used to lavage the frontal sinuses. A small circular incision of about 2cm in diameter was made on the clipped skin of the left lateral abdomen (donor site) (Figure 3) and the epidermis with the dermis were removed from the incised donor site (Figure 4). The graft bed (donor site) was then covered with moisten gauze.

The donor skin was then transferred to the skin surrounding the left horn bud (recipient site) and was sutured to the surrounding granulation skin tissue using a simple continuous suture pattern with nylon suture material (Figure 5). The graft bed (donor site) on the abdomen was sutured using simple continuous suture pattern with nylon suture material (Figure 6). The procedure was repeated to the right lateral abdomen and horn bud.



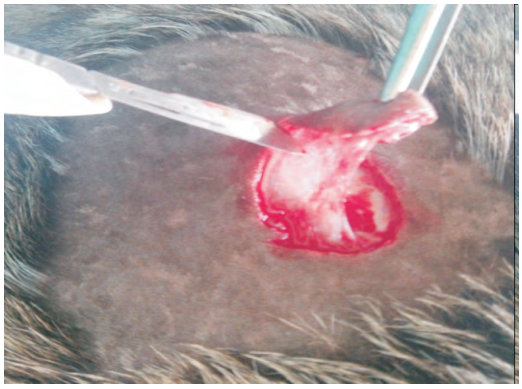
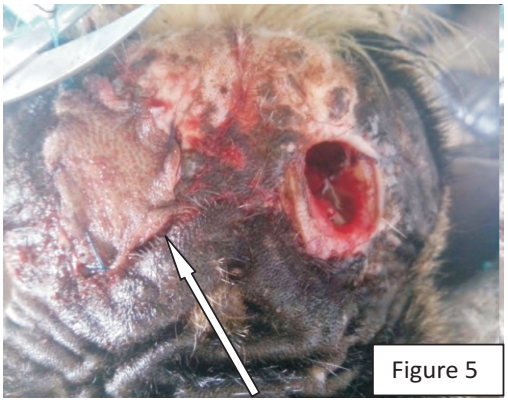


Figure 3: Circular incision on the donor site (arrow).
Figure 4: Epidermis and the dermis (arrow).



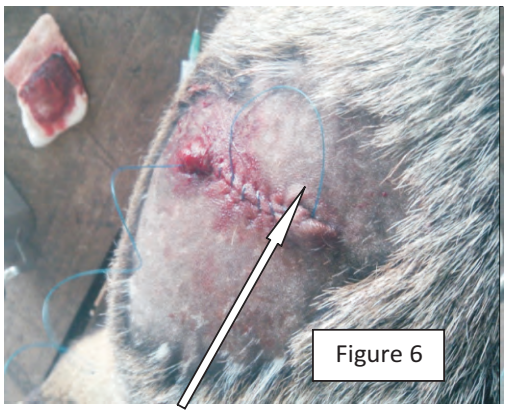


Figure 5: The graft skin sutured to the recipient site (arrow)
Figure 6: The graft bed sutured with simple continuous suture pattern with nylon suture material (arrow)

Post-operative management: A self-adhesive bandage was used to cover the recipient sites to prevent motion at the graft sites (Figure 7), while 1 ml of Penicillin-streptomycin was infiltrated into each surgical site (the donor and recipient sites). Atipamizole at the rate 0.5 dose of xylazine was used to reverse the effect of xylazine. Penicillin-streptomycin at 20,000 IU/20mg per kg was administered intramuscularly for five days and Flunixin was administered intramuscularly at the rate of 2mg/kg for five days.

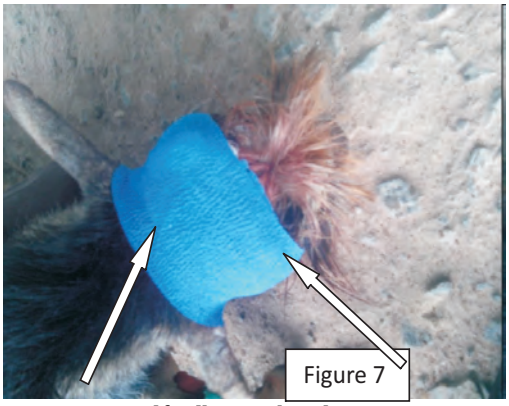


Figure 7: A self-adhesive bandage wrapped on the recipient site (arrow)

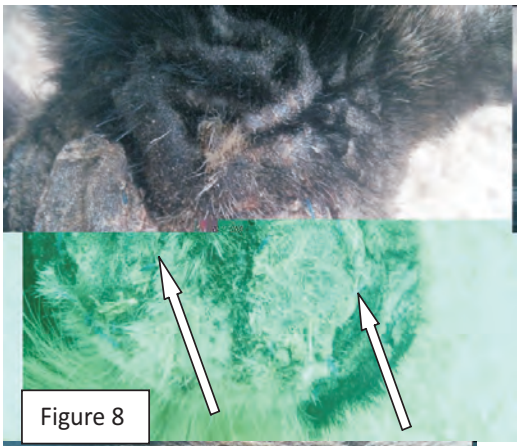


Figure 8: Recipient sites (arrows)
Figure 9: Donor site (arrow)

Results and Discussion

From this report, horn overgrowth appears to be a common feature in the study area especially in WAD bucks. The underlying tissues and skin around the base of the horn were undermined and the horn cut to the base in order to make a skin flap over the horn bud after removing the horn (5). Complete healing following dehorning may not occur as was recorded in this report. The skin flap did not appose well enough, resulting in suture breakdown and the base of the horn was opened up. It was on the basis of this that autogenous-skin-graft was adopted in the management of the arising complications (13).

The healing of the graft on both sides of the head was eventful (Figures 8 and 9) by fourteenth day post-grafting. By this time, inosculation between the grafts vessels and the recipient sites had taken place. The report also shows that sinusitis can be a major complication of dehorning in veterinary practice particularly in domestic ruminants. Efforts toward preventing this condition necessitated the use of initial pedicle-graft in the closure of the sinus openings. The failure of this procedure is not surprising since the skin around the horn is constricted. The failure could have resulted either due to the gaping of skin sutures due to pressure on the skin or incomplete apposition following insufficient skin tissue to bring together.

In the experience of the authors, the use of skin graft as a management strategy for apposition failure in dehorning especially in goats and cattle has not been reported in the study area. In the wound preparation and skin grafting procedure, a wound bed of granulation tissue (pink red healing tissue) created by the wound edge at the base of the dehorned horns provides the ideal bed for a successful graft (20, 21). In elective cases, healthy granulation tissue bed is allowed to develop between 7 to 10 days. In this procedure, debridement was done to trim the excess granulation tissue formed at the rim of the sinus openings in the skull.

In the procedure, like in dogs, abdominal area can provide a donor skin for the grafting in goats. Though the report did not observe complications in creating surgical wounds at the abdominal area, tension-releasing-incision technique around the base of the skull may have provided a credible alternative to the transplantation technique. The inosculation of the vessels of the granulation tissue (the host bed) and the donor graft contributed to the success of the graft-autogenous skin transplantation has demonstrated to be the most successful graft due to absence of tissue rejection.

Though goats are classified as food animals, in some societies, they are regarded as pets. In other to observe ethical conduct in the treatment of the cases, dehorning was done under general anaesthesia or sedation and local anaesthesia due to the anatomy of the tissues involved and the significant development of horny tissue in older goats- bucks as earlier demonstrated by (22).

Maximum welfare of the animals in the course of the procedure and shortly after the procedure was ensured using xylazine® as sedative to provide

maximum restraint and cooperation by reducing anxiety and providing calmness, this was as reported by (7). Desensitization of both palpebral and auriculo-paplebral nerve supply to the horn and also analgesia during and shortly after the dehorning was satisfactory using the ring block technique, this agreed with the works of (2, 23) .

The gauze that was applied to the frontal sinus after dehorning was to prevent foreign agent and fly larvae from getting into the sinus which can cause irritation to the mucous membrane of the sinus. Penicillin-streptomycin was infused to the surgical sites to prevent bacterial infection because these sites can serve as a route of entry for various micro-organisms. Penicillin-streptomycin was also administered for five days by intramuscular injection to act systemically **(8)** .The skin graft used in apposing the skin of the frontal sinuses was successful, it was used to prevent entry of foreign agents which may irritate or cause infection to the frontal sinuses. The healed skin (wound) around the horn bud was debrided so as to allow blood circulation for nutrition of the graft skin, this agreed with the report of (24).

In conclusion, minimizing pain associated with dehorning is important to limiting the pain-stress-distress cascade that creates altered behavioural and physiologic states of the patient. Pre-emptive analgesia can be accomplished with sedation, general anaesthesia, local anaesthesia, and pre- and postoperative administration of analgesics. The use of skin grafts is the most commonly performed procedures to close defects unable to be closed with the simple approximation of the wound edges. Tension–releasing-incision was suggested as an alternative to autogenous- grafting in other to minimize post-surgical complications associated with double surgery in autogenous- skin grafting and the anaesthetic risks. Disbudding at early stage of life in bucks prone to in-growing horns is recommended to animal owners as a management practice to avoid horn overgrowth at older stage

Table 1: Mean Values of Packed Cell Volume (PCV) and Leukogram of the bucks before the skin graft

Parameter	Value	Reference range (Merck, 2005)	Comment
PCV	28%	22-38%	Normal
WBC (total)	$7.3\times10^3/\mu L$	$4\text{-}13\times10^3/\mu L$	Normal
Neutrophils	$5.84\times10^3/\mu L$	$1.2\text{-}7.2\times10^3/\mu L$	Normal
Lymphocytes	$1.314\times10^3/\mu L$	$2\text{-}9\times10^3/\mu L$	Normal
Monocytes	$0.073\times10^3/\mu L$	$0\text{-}0.55\times10^3/\mu L$	Normal
Eosinophils	$0.073\times10^3/\mu L$	$0.05\text{-}0.65\times10^3/\mu L$	Normal
Basophils	0	$0\text{-}0.12\times10^3/\mu L$	Normal

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