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# Impact of using Wooden Spoon as Eye Protection in Ablation of Bovine Ocular Growth with Carbon Dioxide Laser

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**Abstract:** *Twelve bovines with ocular growths were selected and randomly divided into two groups with six animals in each group. In Group 1 saline soaked gauze piece while, in Group 2 saline soaked sterile wooden spoon was used for corneal protection during surgery. All the 12 animals were sedated with xylazine @0.1 mg/kg b.wt. i/m. The anaesthetic induction and maintenance with double drip solution using guaifenesin @50 mg/kg bwt and ketamine @2 mg/kg bwt i/v in 5% DNS was followed. The 9-10 W power output in continuous mode used in both groups in excising all ocular growths in bovines and left unsutured. Postoperative treatment was given for 5 days. In group 1 healing was uneventful in four animals while ocular discharge was observed in two cows. In group 2, majority of the animals (5/6) showed uneventful recovery except one cow which showed corneal opacity and discharge at 3rd day after surgery due to self mutilation. All 12 excised tumor samples were examined microscopically and diagnosed as squamous cell carcinoma (SCC). All 12 animals did not show reoccurrence at least 3 month post surgery.*

**Keywords:** Wooden spoon, Schirmer tear test, Fluroscein dye test, Ocular growth, Carbon dioxide laser, ocular temperature, infrared thermometer, Squamous cell carcinoma (SCC)

## I. INTRODUCTION

Exposing adult animals to radiation outdoors or tethering them outside may lead to an increased risk of eye cancer. Studies have shown that breed-specific patterns in cattle indicate that Holstein Friesian crossbred cows exhibit the highest incidence of eye cancer, followed by Jersey crossbred cows and non-descript cows. It is important to consider these factors when performing laser surgery on the eyes of cattle to ensure the best possible outcome and to minimize the risk of complications. Laser surgery has become a popular method for treating various eye conditions in cattle, and it is crucial to ensure proper eye lubrication and tear production during these procedures. We have discussed the implications of dry eye and the importance of monitoring tear production in cattle undergoing laser eye surgery.

**Materials and methods:**

The surgical resection of ocular growths in the twelve animals was conducted using $CO_2$ laser. The animals were divided into two groups, with six cases in each group. Group I received eye protection in the form of saline-soaked gauze pieces (N=6), while Group II received saline-soaked sterile wooden spoons for eye protection (N=6).

Prior to anesthesia, the eye lashes were clipped with scissors and the surgical site was prepared aseptically by irrigating with copious normal saline. The animals underwent a preoperative stabilization process, including withholding feed and water for 12 hours before anesthetic induction. Preoperative stabilization was carried out by intravenous administration of normal saline and 5% dextrose normal saline. Xylazine was administered at a rate of 0.1mg/kg bwt I/M, and the animals were restrained in lateral recumbency.

**Schirmer tear test (STT) I :**

The schirmer tear test I was utilized using whattman filter paper no.41 strip. Animals were carefully held in a standing position with their heads positioned above the heart in a natural physiological alignment. No pressure was exerted on the neck during restraint, and minimal manipulation of the eyelids occurred. The Schirmer Tear Test (STT) I involved

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placing a standardized sterile strip into the central aspect of the ventral conjunctival sac for one minute. Tear production, measured in mm/minute, was promptly recorded upon removal of the strip from the conjunctival sac. (Tofflemire *et al*. 2015) .

**Fluorescein dye test :**

During the fluorescein dye test, the study animals were placed on the floor without any restraints, allowing them to freely orient their heads. Following a minimum of fifteen minutes after the Schirmer tear test (STT) procedure, a moistened strip containing fluorescein was delicately applied to the dorsal bulbar conjunctiva of both eyes of each animal to transfer the stain (Binder and Herring, 2010). This action facilitated the corneal stroma's absorption of the fluorescein stain, causing it to exhibit a green hue, which delineated the corneal ulcer margin and revealed further details of the surrounding epithelium. (Farghali *et al.* 2021) .

**Fig.1** Using saline soaked gauze to protect the cornea from laser

**Fig.2** Using wooden spoon to protect the cornea from laser

**Surgical technique:**

In group 1, saline-soaked gauzes were utilized to digitally shield the cornea before commencing the excision of the mass using a $CO_2$ laser set at a power output of 9-10 W in continuous wave mode, along with a 0.2 mm spot diameter. The laser beam maintained a distance of approximately 2 cm above the surgical site. Throughout the procedure, a fume evacuator was employed to eliminate the plume generated by the laser treatment, in accordance with the manufacturer's recommendations. As the mass was excised, it was retracted to ensure optimal tissue tension. Stay sutures with cotton thread were employed to fully elevate the ocular growth for contactless excision. To prevent collateral thermal damage to surrounding tissues, any char formation was meticulously removed using saline-soaked gauze. Continuous application of laser energy was directed to the base of the mass until complete excision was achieved. Vessels were cauterized using the $CO_2$ laser itself, with a power output of 4-5 W. To ensure thorough treatment, a crosshatched pattern was employed to cover the tumor bed. Multiple passes of the $CO_2$ laser beam were made in perpendicular directions until tissue caramelization (fig.4) was evident, utilizing a power output of 4 W in continuous wave mode and a spot diameter of 0.4 mm. Minimal to no hemorrhage was observed during the procedure, and the surgical sites were left to heal naturally without closure (second intention healing) (Paczuska *et al*., 2014).

In group 2, a moistened autoclaved disposable wooden spoon coated with sterile lignocaine gel was used to shield the eyeball from potential laser-induced damage to the cornea. The spoon was carefully applied to the cornea to provide protection during the procedure.

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**Fig.3** Ablation of ocular growth using $CO_2$ laser

**Fig. 4** Caramelization of surgical bed post surgery

**Surgical Bed Temperature:**

Surgical bed temperature was recorded by infrared thermometer and expressed in Fahrenheit (˚F) to assess the degree of thermal damage. (Figure 7 & 8)

**Postoperative care:**

Postoperatively, Inj. Strepto-penicillin at a dosage of 10000 IU/kg body weight and Inj. Meloxicam at a dosage of 0.5 mg/kg body weight were administered for 5 days. Ofloxacin eye drops were applied during the recovery period. Post-operative complications, including corneal opacity of the eyeball and corneal ulceration, were visually observed. Telephonic follow-up was conducted to monitor recurrence for a minimum of 3 months. To confirm the diagnosis of the excised growth, histopathological examinations were performed on tumor tissues. Tissue samples were collected from various locations within the tumor beds, including Dorsal, Ventral, Lateral, and Medial regions, to assess the presence of tumor cells.

## II. RESULTS

**Schirmer tear test I**

Schirmer tear test was carried out on different time intervals viz preoperative, post operative, 7$^{th}$ day and on 21$^{st}$ day (Table 1).

**Table 1 Mean ± SE values of Schirmer tear test (STT) I values in bovines with ocular growth (n=12)**

| parameter | Groups | Preoperative | Post operative | Day7 | Day 21 | P value |
|---|---|---|---|---|---|---|
| STT (mm/min) | G1 | $19.00 \pm 2.18^{b}$ | $13.33 \pm 1.52^{a}$ | $20.83 \pm 1.90^{b}$ | $24.00 \pm 0.52^{b}$ | 0.020 |
| | G2 | $19.17 \pm 2.43^{b}$ | $13.00 \pm 2.11^{a}$ | $19.33 \pm 1.28^{b}$ | $25.67 \pm 0.71^{c}$ | 0.01 |
| | P value | 0.960 | 0.901 | 0.528 | 0.088 | |

Mean bearing different subscripts (a, b) differ significantly ($p < 0.05$) within row

In group 1, the mean values of Schirmer tear test (STT) I in mm/min were 19.00 ± 2.18 preoperatively, 13.33 ± 1.52 immediately postoperative, 20.83 ± 1.90 on day 7 postoperative, and 24.00 ± 0.52 on day 21 postoperative. For group 2, the mean values of Schirmer tear test (STT) I in mm/min were 19.17 ± 2.43 preoperatively, 13.00 ± 2.11 immediately postoperative, 19.33 ± 1.28 on day 7 postoperative, and 25.67 ± 0.71 on day 21 postoperative.

The mean preoperative STT I values in both groups remained within the normal reference range of 9 to 34 mm/min (Tofflemire *et al*., 2015) throughout the study. Tear production significantly decreased ($P < 0.05$) compared to preoperative values in both groups. Subsequently, in group 1, the STT I value increased, with no significant difference observed on days 7 and 21 compared to preoperative values. In group 2, this increase in STT I value was non-significant on day 7, while a significant ($P < 0.05$) increase was observed on day 21 postoperatively compared to preoperative STT I values. The initial decrease in STT I value immediately after surgery may be attributed to eye dryness caused by the heat generated by the $CO_2$ laser. When comparing group 1 and group 2, no significant difference

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was observed in the mean STT I values at various time intervals. This suggests that the type of eye protection device used during laser surgery does not have a significant effect on the mean STT I values.

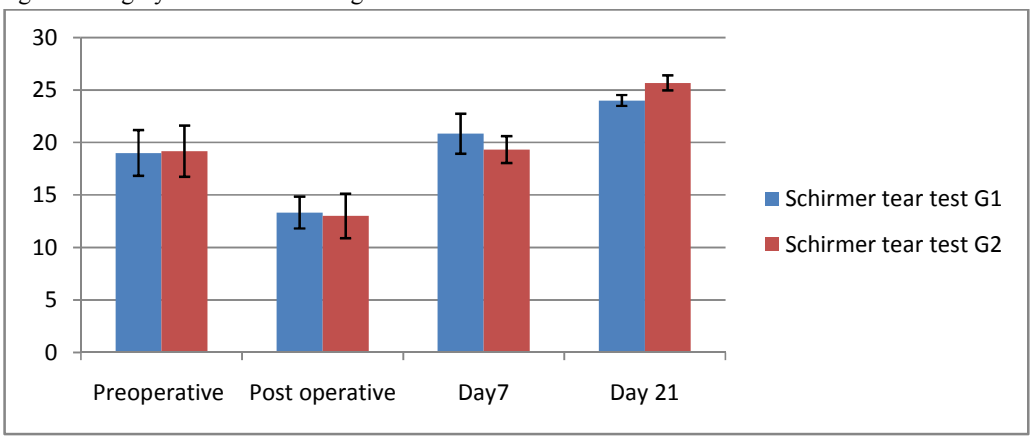


Figure 3: Column graph showing schirmer tear test parameters in bovines

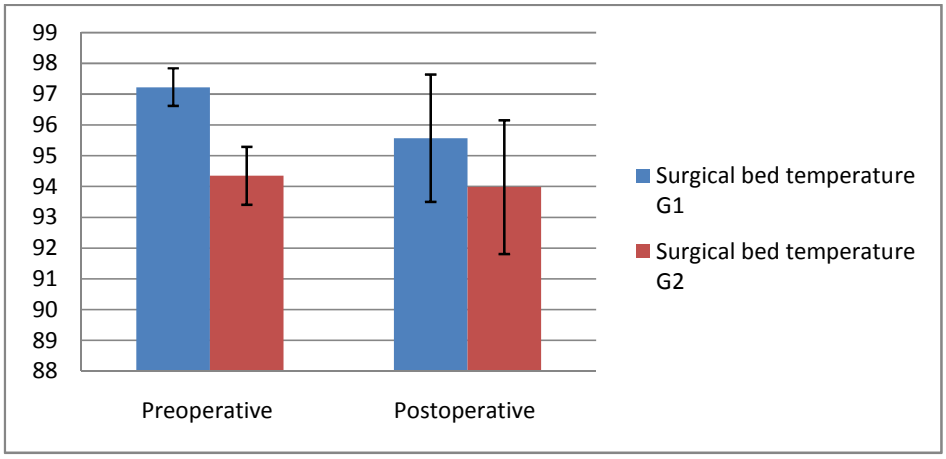


Figure 4: Column graph showing surgical bed temperature in bovines

**Fluorescein dye test**

In group 1, the Fluorescein dye test yielded negative results, indicating no uptake of fluorescein dye by the cornea preoperatively as well as on days 7 and 21 postoperatively. However, immediately after surgery, all animals in group 1 exhibited a positive result with grade 1 corneal ulcer (Figure 4.3). This could potentially be attributed to corneal abrasion caused by the gauze used to protect the cornea from laser damage during surgery. Laser injury is known to be a potential cause of corneal ulcers. In contrast, in group 2, the fluorescein dye test yielded negative results at all observation points, including immediately after surgery (Figure 4.4), indicating that the soaked wooden spoon not only effectively shielded the cornea from the laser but also prevented the abrasions observed in group 1.

**Surgical**

In both groups, a $CO_2$ laser with a power output of 9 W in continuous wave mode and a spot diameter of 0.2 mm effectively removed ocular growths with dimensions smaller than 34 x 16 mm (8 out of 12 animals). However, for growths with larger dimensions, the power output had to be increased to 10 W in 4 animals to achieve effective tumor ablation. The utilization of 9-10 W power output in continuous mode, with a working distance of approximately 2 cm, proved efficient in excising all ocular growths in bovines.

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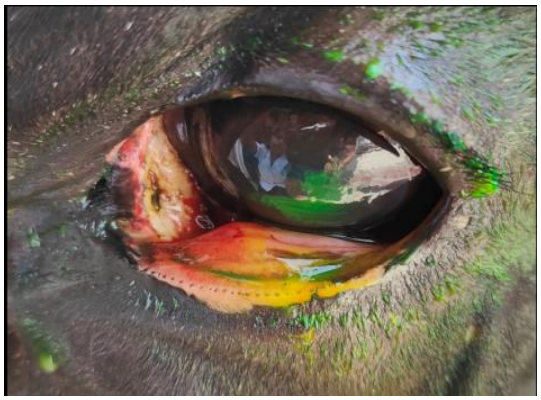


(Fig. 5 positive fluorescein dye test immediate after surgery G1) (Fig.6 negative fluorescein dye test immediate after surgery G2)

In group 1, saline-soaked gauzes were employed to digitally shield the cornea during laser surgery, requiring repeated manual adjustments to maintain protection. Conversely, the wooden spoon used in group 2 was easier to manipulate and effectively shielded the cornea due to its longer handle. Additionally, the wooden spoon did not experience perforation, though black discoloration was noted on the surface facing the laser beam at the end of the surgery.

Following tumor removal, a crosshatch pattern was employed to control bleeding and ensure thorough ablation until visualization of light brown tissue discoloration, known as caramelization. In all animals, the surgical wounds were allowed to heal by secondary intention without primary closure.

**Surgical bed temperature:**

In group 1, the mean values of surgical bed temperature were 97.23 ± 0.61 preoperatively and 95.57 ± 2.07 postoperatively. In group 2, the mean values were 94.35 ± 0.94 preoperatively and 93.98 ± 2.17 postoperatively. There was no significant difference observed in the pre and postoperative surgical bed temperatures in both groups (Table 2, Figure 7 & 8). The absence of significant temperature change in this study may be attributed to the use of a low-power laser for a very short duration.

**Table 2 Mean ± SE values of surgical bed temperature values in bovines with ocular growth (n=12)**

| Parameter | Groups | Preoperative | Postoperative | P value |
|---|---|---|---|---|
| Surgical bed temperature (˚F) | G1 | 97.23 ± 0.61 | 95.57 ± 2.07 | 0.488 |
| | G2 | 94.35 ± 0.94 | 93.98 ± 2.17 | 0.907 |
| | P value | 0.027 | 0.610 | |

**Fig. 7 & 8** Surgical bed temperature before surgery and after surgery

**Complications and Reoccurrence**

In group 1, healing progressed without any issues in four animals, while two cows exhibited ocular discharge, which resolved after 4 days of therapy. In group 2, the majority of the animals (5 out of 6) experienced uneventful recovery,

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except for one cow which developed corneal opacity and ocular discharge on the 3rd day after surgery due to self-mutilation. All three cows with corneal opacity and ocular discharge were treated by local irrigation with a powdered boric acid solution in normal saline and chloramphenicol eye drops, leading to complete recovery.

**Histopathology:**

All 12 excised tumor samples were examined microscopically and diagnosed as squamous cell carcinoma (SCC). In both groups, the majority of SCCs were well-differentiated (8 out of 12), characterized by a low mitotic index below 0.5-2.5, followed by moderately differentiated SCCs (4 out of 12) with a mitotic index of 1.5-1.9. There was no observed recurrence in either group for up to three months. Immunohistochemistry was performed, and positive immunoreactive cells were counted, revealing a Ki-67 index ranging from 25-37% in both well-differentiated and moderately differentiated SCCs.

## III. CONCLUSION

Therefore, it is concluded that ablation of ocular squamous cell carcinomas was satisfactorily achieved using a 9-10 W $CO_2$ laser in continuous mode, with a 0.2 mm spot diameter and an approximate 3 cm working distance, without causing dryness of the eyes or significant postoperative temperature elevation in the surgical bed. The use of a sterile wooden spoon proved highly effective in shielding the cornea from incidental damage during the ablation of ocular squamous cell carcinoma, as evidenced by the absence of corneal ulceration. Minimal manipulation was required, reducing the total ablation duration. Histopathologically, all 12 cases were diagnosed as well to moderately differentiated squamous cell carcinoma, with a mitotic index ranging from 0.5 to 2.5 and a Ki67 index ranging from 29 to 37%. None of the 12 animals exhibited recurrence within at least 3 months post-surgery.

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