**SURGICAL MANAGEMENT OF TRAUMATIC TEAT FISTULAS WITH POLYESTER SUTURES**

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**Abstract**: A total of 6 cows presented to Department of veterinary Surgery and Radiology, Teaching veterinary clinical complex, Rajiv Gandhi Institute of Veterinary Education and Research, Pondicherry with traumatic teat fistulas were selected for the present study. Upon preoperative evaluation, the mucosal and muscular layers were sutured separately by simple continuous suture pattern using polyglactin 910. The skin edges were apposed by using braided and polybutilate coated polyester sutures. Postoperative evaluation of the reconstructed teat was carried out by the morphological evaluation and ultrasonographical evaluation.

**Keywords:** Cows, Traumatic teat fistula, polyglactin 910, braided and polybutilate coated polyester sutures.

**Introduction**

Udder and teat health care is increasingly important for dairy farmers since disease condition involving them ultimately affects the productivity causing heavy economic loss (Abd-El-Hady, 2015). The bovine teat is composed of five layers viz. mucosa, sub-mucosa, highly vascularized connective tissue, muscularis and the skin (Hendrickson, 2007). The occurrence of teat injuries in milking cattle can be categorized as stenosis (31.5%), laceration without perforation (22.2%), skin wound (21%), rupture or splitting (20%) and perforating injury (4.9%) (Beuch *et al.* 1987). Teat lacerations are rarely clean, straight and incised wound, many are flap wounds with irregular shapes and depth of penetration (Molaei and Ebrahimi 2013).

The teat injuries are classified into two categories viz., external or “uncovered” lesions and internal or “covered” lesions (Nichols 2009). They can also be classified as superficial and deep based on the different layers involved (Nouh *et al.* 2014). External injuries include all types of lacerations involving different layers of teat wall and the internal injuries include that of the teat cistern and papillary duct (Sreenu *et al*., 2014). Most of the teat injuries occurs when cattle housed (78%) than when they were kept in pasture (21%) of the cases (Molaei *et al.* 2002). They were often self-inflicted when the cow stands and can occur in tie stall or free stall barns (Nichols *et al.* 2016). The teat wounds are common during parturition as a result of increase in the udder size and clumsy movement of the cow and there is a higher incidence in animals aged five or six years, i.e. during the early lactation (Molaei and Ebrahimi 2013). The authors also reported that most of the teat injuries occur within one month of calving, when cows are in high production. Use of appropriate suture material on bovine teat with the appropriate suture pattern will yield better results (Couture and Mulon 2005).

The sutures made of polyester were strongest non-absorbable synthetic suture material currently available. They are superior to nylon, polypropylene and polybuster and are second only to stainless steel sutures (Banks *et al.* 2001). They are non-absorbable synthetic braided multifilament composed of polyethylene terephthalate having properties, such as minimal tissue reactivity, high tensile strength, good handling and everlasting. They were available as plain and coated with polybutilate, teflon or silicone (Kudur *et al.* 2009).

**Materials and Methods**

Six cows presented to the large animal surgery ward of Teaching Veterinary Clinical Campus, Rajiv Gandhi Institute of Veterinary Education and Research (RIVER) and were diagnosed to have deep lacerated wounds with exposed teat cistern (Fig. 1) were selected for the present study. The animal particulars viz; breed, age, body weight, feeding pattern- grazing/ stall feeding, stage of lactation, calving history were documented. A complete history was obtained from the farmer regarding the time of occurrence of wound and its duration and its etiology. Clinical examination of the affected teat was performed and the parameters included were udder morphology, teat which was affected, shape of the affected teat, and length of the teat (Table 1). Milkability of the affected teat was assessed on the day of presentation and after the suture removal using the following parameters viz; milk yield per quarter (kg), nature of milk flow and milk flow rate of the affected quarter (kg/min) by hand milking. The milk quality was assessed by its colour, consistency, pH, California mastitis test and somatic cell count (1x105cells/ml) on the day of presentation and suture removal.

Following preoperative evaluation, Food and water was withheld for 12-18 hours prior to surgery in all the animals and they were sedated with Inj. Xylazine at the dose rate of 0.1mg/kg intravenously and ring block technique was employed with 0.5% Bupivacaine hydrochloride.

The wound was irrigated with 0.5% Povidone Iodine solution and the margins were thoroughly debrided using No. 11 scalpel blade. The suturing of first layer of teat included inner mucosal layer in simple continuous pattern, muscular and connective tissue in simple continuous pattern were done with polyglactin 910 No. 3/0 in all the animals. Braided polybutilate coated polyester sutures of size 2/0 (Ethibond Excel – Ethicon, Johnson and Johnson private limited, India) was applied in simple interrupted pattern for apposing the skin wound edges (Fig. 2).

A sterile modified polyvinyl tube (Infant feeding tube No. 10, Romsons Scientific and Surgicals India) was placed in the teat to maintain the patency and fixed with stay sutures. A sterile disposable 2ml syringe was connected to the modified polyvinyl tube and closed. Postoperatively Inj. Meloxicam @ 0.5mg/kg and Inj. Streptomycin – Procaine penicillin (Dicrysticin- S- Zydus AHL) @ 10mg / kg body weight were administered intramuscularly for 7 days. Postoperatively the surgically corrected teat was evaluated on 7th and 10th day post-operatively by taking the parameters viz; Intactness of sutures, No. of sutures present, Nature of suture line (dry/ moist), Nature of the suture site (soiled/ contaminated), presence of discharge Wound dehiscence if any.

**Results and Discussion**

Out of six animals five animals were cross bred Jersey and one was Holstein Friesian cross with an age group of 3 to 7 years, similar findings were reported by Ghamsari *et al*. (1995), Ghamsari *et al*. (1996) Mahdy (1998) and Nouh *et al*. (2014). Among all the animals four cows were allowed for grazing and two were fed install. Stall fed animals were kept in closed enclosure and more prone for teat injuries due to stamping. Similar findings were reported by Matzke *et al*. (1992), Molaei *et al*. (2002), Nichols (2008), Nouh *et a*l. (2014) and Nichols *et al*. (2016).

The calving history ranged from 6 to 25 days as they were all in their first stage of lactation. The present findings were in agreement with Bristol (1989) who stated that most teat injuries occurred within one month of calving, when cows were in high production. However, Molaei and Ebrahimi (2013) reported that teat wounds were common around parturition as a result of udder size and movements of the cow.

The duration of wound was in between 2-20 days and the etiological factors of the wound were due to thorn in three animals, treading in two and barbed wire in one case. Mulon (2016) and Nichols *et al*. (2016) who reported that due to overcrowding of animals with enlarged udder after calving in tie stall or free stall barns puts the teat at risk of self-inflicted injury or by the other animals. Sreenu *et al.* (2014) stated that poor udder conformation, with low hanging teats predisposes the teat to being kicked by the cow causing injuries.

Udder morphology of the animal studied on the day of presentation which revealed three animals had bowl, pendulous in two and globular shaped udder in one. These findings deferred with Tiwary *et al.* (2005) who reported that the teat laceration was mostly observed in those animals that have long teats and pendulous udder.

The affected teats were right hind teat in three animals and one had in right fore teat, left hind teat and left fore teat. Molaei and Ebrahimi (2013) stated that the hind teats are more frequently affected than the fore teats and vice versa. The incidence of injury to the right and left side is approximately equal (Bristol, 1989). The shape of the affected teats were cylindrical shaped in five cows and funnel shaped teat in one cow. The length of the affected teats ranged between 6-9cm, which indicates longer teats were prone for injuries (Grommers *et al.*1971).

Milkability detection on the day of presentation was found to be difficult as the milk was dribbling from the affected teat and was difficult to assess. Whereas on the 10th postoperative day the milk yield per quarter (kg), nature of milk flow and milk flow rate of the affected quarter (kg/min) by hand milking observed as the Mean ± S.E. was 0.07 ± 0.01. In all the cases deep laceration from skin to mucosa communicating the cistern, caused dribbling of milk from the injured site. So it was difficult to assess the milkability on the day of presentation. Similar statement was reported by Nichols (2008) and Mulon (2016).

The milk was apparently normal without any change in colour, consistency and pH on the day of presentation and 10th postoperative day (Table 2). California mastitis test was negative and somatic cell count (1x105cells/ml) on the day of presentation was of (Mean ± S.E.) 278015 ± 12631.91 and on the 10th postoperative day it was of 363568.5 ± 19654.31, which were found to be within normal range, since all the animals were treated with antibiotic therapy and the wound was protected with Dynafix without any contamination. Similar findings were recorded by Aruljothi *et al*. (2012), Tiwary *et al*. (2006) and Khan and Khan (2006).

Administration of Inj. Xylazine to induce sedation and ring block with 0.5% Bupivacaine were found to be effective to carry out the surgical procedure as suggested by Nichols (2009), Marongiu (2012), and Ismail (2016).

Irrigating with 0.5% Povidone Iodine solution and thorough debriding the wound margins were found to be very effective to freshen the surgical site (Nichols, 2008; Aruljothi *et al.,* 2012 and Mulon, 2016). The mucosal and the muscular layers were sutured in simple continuous pattern separately with polyglactin 910 No. 3/0. Three layer suture pattern was adopted in the present study and was found to be very effective in complete closure of the teat cistern (Ghamsari *et al*., 1995; Nichols, 2009; Aruljothi *et al.,* 2012 and Balagopalan and Aruljothi, 2016).

Braided and polybutilate coated polyester sutures were used to close the skin and the number of sutures applied ranged from 5 to 12 numbers which depended on the length, direction and size of the wound as they are synthetic braided sutures that lasts indefinitely in tissues. They are primarily used in humans for tendon lacerations in which the sutures remain within the tissues for longer periods (Singer 2011). The suture pattern employed was simple interrupted pattern as explained by Nichols *et al*. (2016).

Morphological evaluation was done on 7th postoperative day (Table 3) and the all sutures were intact in (33%) of animals whereas not intact in four animals (67%) (Fig. 3). The average number of sutures present were only 5.3 and this could be due to its multifilament nature, poor knot security, causing more tissue reaction and increasing the inflammatory response. The application of polyester sutures might have caused persistent local infection and exaggerated tissue reaction (Boothe, 2003).

The nature of suture line was dry only in 33% of the animals whereas moist in 67% which could be due to the inflammatory response at the suture line and multifilament nature of the suture material favouring infection. Similar findings were reported by Boothe (2003) and Fossum *et al.* (2013). The multifilament nature favoured the retrograde infection causing postoperative wound infection (Modi, 2009). The moist nature of the suture line could be due to the presence of discharge at the suture site in 67% animals which resulted in contaminated suture site.

Discharge was noticed at the suture site in four animals (67%) and which was absent in only 33%, which indicated the persistence of local infection at the suture site and exaggerated tissue reaction to the polyester suture favoured the postoperative wound infection and resulted in discharge from the suture site (Banks *et al*., 2001 and Boothe, 2003). The braided nature of the polyester sutures potentiated suture site contamination and further leading to infection (Al-Mubarak and Al-Haddab, 2013). There was no evidence of wound dehiscence in 33% of cases but 67% of the animals had dehiscence due to the contaminated suture site which resulted in increased inflammatory response due to the shredding of the outer coated layer (Boothe, 2003).

The skin sutures were removed on the 10th postoperative day in all the animals (Nichols *et al*., 2016) in which wound dehiscence, fistula formation and gaping of edges were observed.

The moist nature of suture line, contaminated suture site with discharge, postoperative surgical complications like tissue flap necrosis, wound dehiscence and fistula formation with the gaping of wounds exposing the inner lying structures might have caused wound dehiscence and complete wound healing was not achieved in four animals (Azizi *et al*., 2007 and Mulon, 2016). Polyester sutures were not intact in 67% of animals, caused more tissue reaction and increased inflammatory response, contamination of the suture site, persistent local infection and exaggerated tissue reaction as explained by Boothe (2003) and Chellamani *et al.* (2013), whereas 33% of the cases showed uncomplicated wound healing without any dehiscence (Fig. 4).

The in-situ fixing of sterile prosthetic tube made up of modified polyvinyl chloride number 10 was very useful to retain the teat patency and to remove the milk from the affected quarter. Application of adhesive bandage (Dynafix) was found to be effective for protecting the surgical site. Attachment of 2ml syringe to the tube was useful to complete the circuit.

**Conclusion**

The quality of milk and milkability reflected the effectiveness of the technique in regaining the functional capacity of the teat postoperatively. The surgical technique employed for the management of teat wounds with fistula was found to be less effective due to the encountered complications which could be due to the management practices, postoperative care and the suture material.

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**Table 1 Animal Particulars, Anamnesis and Clinical examination (n = 6)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Animal No** | **Breed** | **Age**  **(Years)** | **Body weight**  **(KGs)** | **Feeding Pattern** | **Stage of Lactation** | **Calving History (days)** | **Duration**  **(Days)** | **Etiology** | **Treatment adapted** | **Udder morphology** | **Affected Teat** | **Shape of the affected teat** | **Length (cm)** |
| II A | CBJ | 7 | *280* | Grazing | 1 | 25 | 3 | Thorn | Yes | Bowl | LFT | Cylindrical | 9 |
| II B | HFX | 7 | *320* | Grazing | 1 | 18 | 20 | Barbed Wire | Yes | Globular | RHT | Cylindrical | 6 |
| II C | CBJ | 5 | *287* | Stall Fed | 1 | 20 | 2 | Treaded | Yes | Bowl | RHT | Funnel | 6 |
| II D | CBJ | 6 | *290* | Grazing | 1 | 15 | 10 | Thorn | Yes | Pendulous | LHT | Cylindrical | 8 |
| II E | CBJ | 6 | *310* | Stall fed | 1 | 18 | 5 | Treaded | Yes | Pendulous | RHT | Cylindrical | 7 |
| 1I F | CBJ | 4 | *318* | Grazing | 1 | 6 | 2 | Thorn | Yes | Bowl | RFT | Cylindrical | 8 |

**CBJ –** Cross Bred Jersey, HFX – Cross Bred Holstein Frisian

**LFT**- Left Fore Teat; **RFT –** Right Fore Teat; **RHT** – Right Hind Teat; **LHT** – Left Hind Teat

**Table 2 Qualitative examination of milk on the day of presentation and on 10th Postoperative day (n=6)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Animal No** | **Milkability** | | **Colour of milk** | | **Consistency of milk** | | **pH** | | **California mastitis test** | | **Somatic cell count**  **(1,00,000 cells/ml)** | |
| **Day of presentation** | **10th Postoperative day** | **Day of presentation** | **10th Postoperative day** | **Day of presentation** | **10th Postoperative day** | **Day of presentation** | **10th Postoperative day** | **Day of presentation** | **10th Postoperative day** | **Day of presentation** | **10th Postoperative day** |
| II A | 0 | 0.125 | White | White | Normal | Normal | 6 | 6.5 | Negative | Negative | 234698 | 288347 |
| II B | 0 | 0.102 | White | White | Normal | Normal | 7 | 7.5 | Negative | Negative | 318965 | 397841 |
| II C | 0 | 0.070 | White | White | Normal | Normal | 7 | 7.5 | Negative | Negative | 306689 | 389547 |
| II D | 0 | 0.025 | White | White | Normal | Normal | 6.5 | 7.5 | Negative | Negative | 279283 | 398376 |
| II E | 0 | 0.080 | White | White | Normal | Normal | 6.5 | 7 | Negative | Negative | 268081 | 317094 |
| II F | 0 | 0.050 | White | White | Normal | Normal | 6.5 | 7.5 | Negative | Negative | 260374 | 390206 |
| Mean ± S.E. |  | 0.075 ± 0.015 |  |  |  |  | 6.58 ± 0.153 | 7.25 ± 0.170 |  |  | 278015 ± 12631.91 | 363568.5 ± 19654.31 |

**Table 3. Morphological evaluation in animals group II (n=6)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Animal no** | **Intactness of sutures** | **No. of sutures present** | | **Nature of suture line** | **Nature of the suture site** | **Discharge** | **Wound dehiscence** |
| 7th day | 0th day | 7th day | 7th day | 7th day | 7th day | 7th day |
| II A | Intact | 7 | 7 | Dry | Not Soiled | No | No |
| II B | Not Intact | 8 | 4 | Moist | Contaminated | Yes | Yes |
| II C | Intact | 6 | 6 | Moist | Not Soiled | No | No |
| II D | Not Intact | 15 | 5 | Moist | Contaminated | Yes | Yes |
| II E | Not Intact | 10 | 6 | Dry | Contaminated | Yes | Yes |
| II F | Not Intact | 12 | 7 | Moist | Contaminated | Yes | Yes |
| **Mean ± S.E.** |  | **9.6 ± 1.4** | **5.8 ± 0.5** |  |  |  |  |

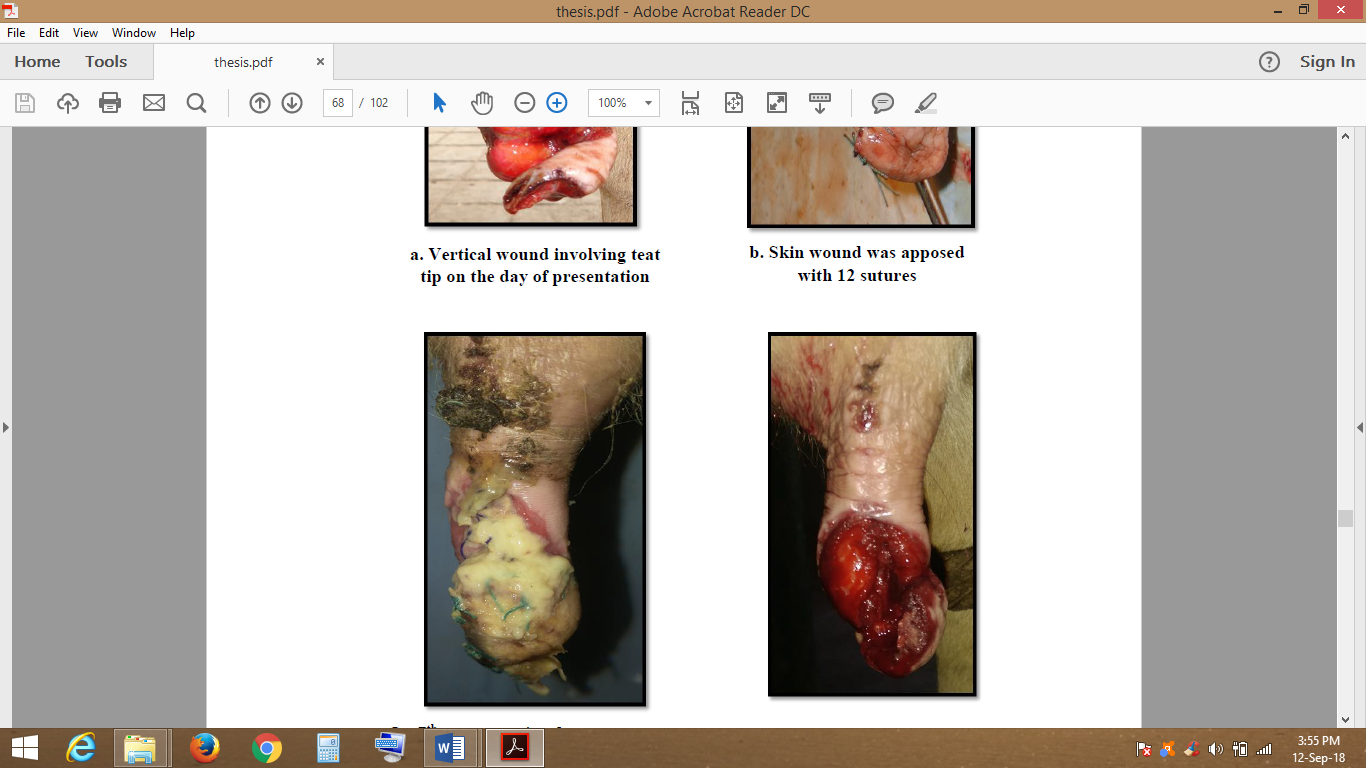
**Figures**

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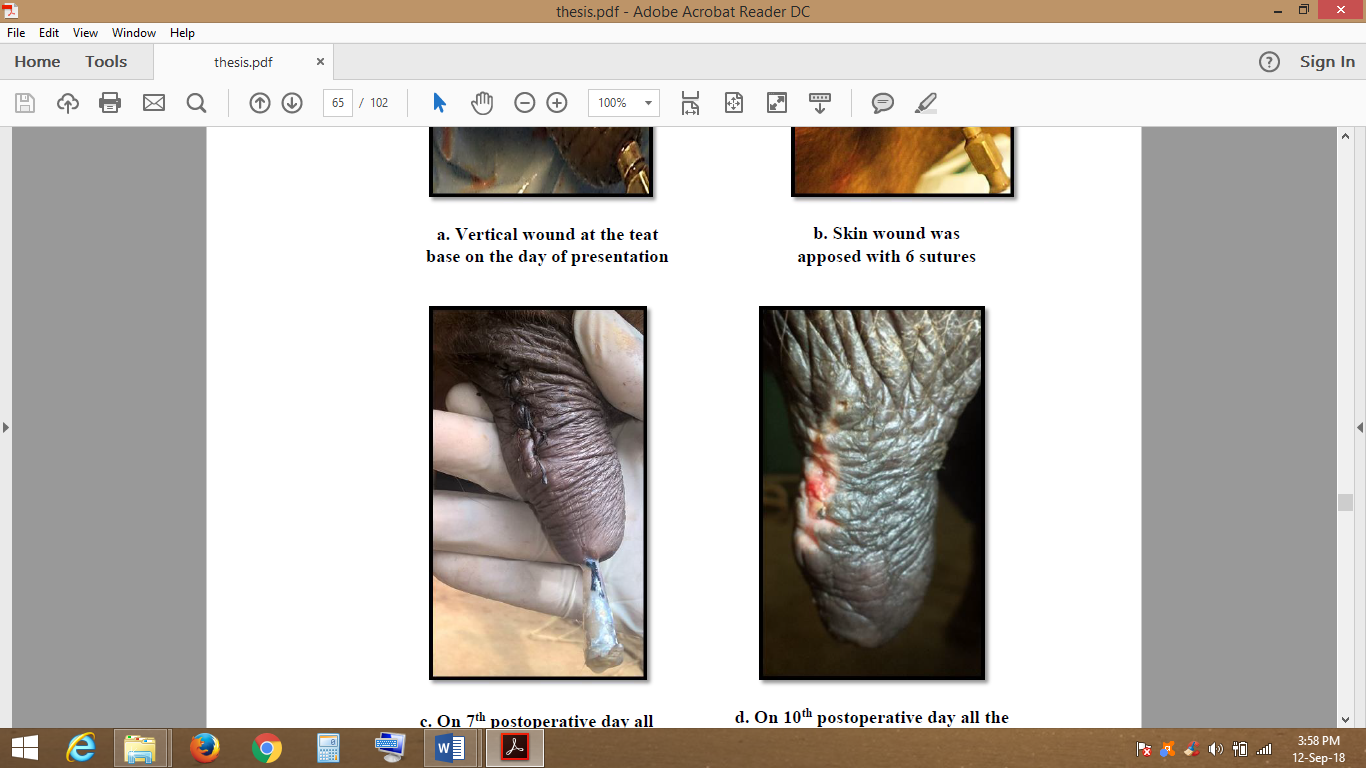
**A) Fig. 1 Showing deep lacerated wounds with exposed teat cistern**

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**B) Fig. 2 Showing Braided polybutilate coated polyester sutures of size 2/0 which was applied in simple interrupted pattern on skin**

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**C) Fig. 3 Showing wound dehiscence, fistula formation and gaping of wound edges on day 7 postoperatively**

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**D) Fig. 4 Showing uncomplicated wound healing without any dehiscence on day 10 after removal of sutures**