Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(4): 1378-1382

Received: 18-05-2018
Accepted: 19-06-2018

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Application of disposable skin staples for external wounds on teat

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Abstract
Present study was conducted in 6 cows presented with deep lacerated wounds with exposed teat cistern at Department of veterinary Surgery and Radiology, Teaching veterinary clinical complex, Rajiv Gandhi Institute of Veterinary Education and Research, Pondicherry. All the cows were subjected to preoperative evaluation and the mucosal and muscular layers were sutured separately by simple continuous suture pattern using 3/0 polygalactin 910. The skin edges were apposed by applying disposable stainless steel skin staples. Postoperative evaluation of the reconstructed teat was carried out by the morphological evaluation on 7th day and 10th day.

Keywords: Cows, deep lacerated wounds, exposed teat cistern, disposable stainless steel skin staples

1. Introduction
In cows external teat injuries are more common because of their anatomical location, increase in size of udder and teats during lactation, faulty methods of milking, repeated trauma to the teat mucosa, injury by teeth of calf, self-infliction, barbed wires, thorny bushes, stamping on teat by other animal etc [24, 22]. 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 [23]. The external teat injuries were classified into superficial and deep injuries [20] and also as partial thickness (skin to submucosa) or full thickness (skin to submucosa with milk leaking out through the defects) [17]. Management of teat injury usually involves teat surgery and is certainly one of the major areas of soft tissue surgery. The repair of teat lacerations, there is a guarded prognosis with a high incidence of dehiscence and fistula formation [16]. Frequent complications encountered upon conventional suturing pattern were suture line leakage and dehiscence of suture line because of the minimum suture holding capacity of the tissue. The success rate of teat surgery was mainly depending on suture quality and effective drainage [25]. Post-operative wound dehiscence was found to be less in stapler sutured wound when compared to conventionally sutured wound [9]. To favor uncomplicated early teat wound healing the present study was carried out for the management of external teat wounds in cows with the application of disposable skin staples.

2. Materials and Methods
A total number of six cross bred Jersey cows diagnosed to have deep lacerated wounds with exposed teat cistern presented to the large animal surgery ward of Teaching Veterinary Clinical Campus, Rajiv Gandhi Institute of Veterinary Education and Research (RIVER), Pondicherry in the year 2017 were selected for the preset study. The animal particulars viz; breed, age, body weight, feeding pattern- grazing/ stall feeding, stage of lactation, calving history, the time of occurrence of wound and its duration, etiology were recorded. Clinical examination of the affected teat was performed preoperatively, and on 7th and 10th day postoperatively. The parameters included were udder morphology (bowl/ globular/ pendulous/ goaty), teat which was affected, shape of the affected teat (cylindrical/ pear/ bottle/ conical/ funnel) and length of the teat. Characteristics of the wound on the day of presentation were recorded.
The midstream milk from the affected teat was collected and studied for its colour, consistency, pH, California mastitis test and somatic cell count on the day of presentation and suture removal.

The affected animals were sedated with Inj. Xylazine at the dose rate of 0.1mg/kg intravenously and positioned on lateral recumbency with the affected teat was placed above and local analgesia with Inj. 0.5% Bupivacaine hydrochloride as ring block was employed. The wound on the teat was irrigated with 0.5% Povidone Iodine solution and debrided The mucosal and the muscular layers were sutured in simple continuous pattern separately with polyglactin 910 No. 3/0 in all the animals (Fig.1) Disposable stainless steel skin staples (Fig.2) having wire diameter 0.57mm, length 6.4mm and width 4.0 mm made up of stainless steel (Acos by Sunmedix-Surgiplus, Pondicherry, India) was applied at a gap of 5 mm for opposing the wound edges. Total number of staples applied on the wound was counted.

Postoperatively a sterile prosthetic tube made up of modified polyvinyl chloride No.10 (Romsons Scientific and Surgicals, India) was introduced into the lumen, placed in-situ and fixed to the skin at the teat tip using braided silk number '0'(Ethicon) following the application of adhesive bandage (Dynafix) under sterile condition. This tube was attached with a 2ml disposable syringe (Fig.3) which was used to drain the milk and also to close the teat canal to avoid post-operative contamination [1, 2, 3]. Inj. Streptopenicillin at the dose rate of 10mg/kg body weight was administered intramuscularly for 7 days. Postoperative evaluation of the reconstructed teat was carried out by the morphological evaluation on 7th day for intactness of staples, number of staples present, nature of suture line, nature of the suture site, presence of discharge and for wound dehiscence if any. On 10th day the suture line was cleaned with surgical spirit in all the animals and disposable skin staples were removed using Stapler remover (Fig.4) (Acos by Sunmedix- Surgiplus, Pondicherry, India).

Fig 1: The mucosal and the muscular layers were sutured in simple continuous pattern with polyglactin 910 No. 3/0

Fig 2: Disposable Skin Stapler

Fig 3: Postoperatively infant feeding tube No 10 placed in-situ and Dynafix applied

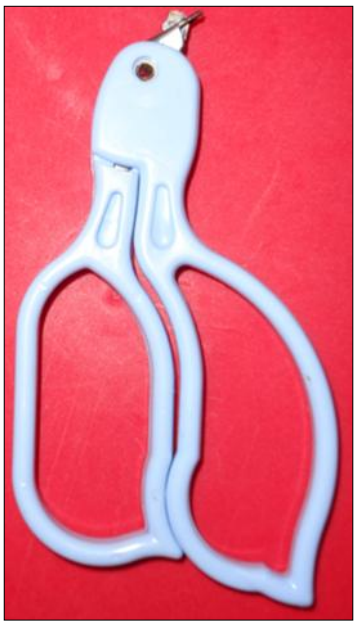

Fig 4: Staple remover

3. Results and Discussion

Out of six cows, one was left for grazing and five were fed install and their bodyweights weighing between 240-326 kg (Table 1). All the animals were in the first stage of lactation. Stall fed animals were kept in closed enclosure and more prone for teat injuries due to treading. Similar findings were reported by [12, 13, 17, 20, 19]. The teat wounds were common around parturition as a result of udder size and clumsy movement of the cow [14] and most teat injuries occurred within one month of calving, when cows were in high production [5]. The duration of wound ranged from 1 to 20 days and the etiological factors of the wound were treading in three animals, thorn injuries in two and barbed wire in one case [20]. Overcrowded 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 neighboring animals [19]. However, [23] poor udder conformation, with low hanging

teats predisposes the teat to being kicked by the cow causing injuries. Udder morphology of was pendulous and bowl shaped in three animals each which 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. In the present study single teat was affected in all the animals, and the affected teats were left fore teat and right hind teat in two each followed right fore teat and left hind teat in one each [20]. The shape of the affected teats was cylindrical shaped in four animals and funnel shaped in two animals. The length of the affected teats ranged from 5 to 12.5cm which indicated that longer teats were prone for more injuries [8].

The colour and consistency of milk on the day of presentation and on 10th postoperative day (Table. 2) were found to be apparently normal in all the animals. The pH ranged from 6 to 7.5 on the day of presentation (Mean ± S.E. values of 6.59 ± 0.23), whereas on the 10th postoperative day it ranged from 6.5 to 7.5 (Mean ± S.E. values of 6.91 ± 0.20). The California mastitis test was found to be negative. The anaesthetic protocol and ring block was found to be effective in the present study [3, 15]. The external wound on the teat was debrided and effectively irrigated with 0.5% Povidone Iodine solution [17, 2, 15]. Three layer pattern was followed in the present study and was very effective in complete closure of the teat cistern [7, 18, 2, 3]. The disposable stainless steel skin staples were used to appose the skin. (Table.3; Fig 5). They were easy to apply, less time consuming, staples entered the skin at equal distances on either side of the wound edge and able to bring proper apposition. Stapling minimized tissue compression, space between staple crown and skin surface reduced cross hatching [10, 11]. The number of staples applied ranged from 5 to 18, depending upon the size and length of the wound; staples were placed at a distance of 5mm from one another. So the number of staples varies in the length, size and direction of the wound and able to be applied easily in accordance with Patel *et al*. (2014). All the applied staples were intact in five animals (83%) except in animal IB (17%). Staples were having better intactness and good tissue holding capacity in five cases. Because stainless steel were virtually inert, caused minimal tissue reaction, rectangular shape design minimizes tissue trauma, tissue compression, space between staple crown and skin surface minimizes cross hatching [11, 4]. On day 7, the average staples were 10.8 which indicated that staples were having good tissue holding capacity than sutures. Stainless steel staples had the tensile strength and it maintained this strength on implantation. The monofilament nature of the staples avoided the migration after application/ implantation [4, 6]. In case IB out of 8 only 5 staples were noticed which was due to etiological factor, location, direction of the wound along with poor management by the owner. The suture line was dry in five animals (83%) (Fig. 6) and moist in IB (17%). The dry nature of suture line indicated that postoperative wound infection was less in staples. The monofilament nature and less reactiveness of staples favoured minimal wound inflammation resulted in dry suture line [9].

The suture site was clean and not contaminated in three cows (50%), whereas in other three (50%) cows the sutured site was soiled with mud and dung. No discharge was observed in five cases (83%) and discharge noticed at the suture site in one animal (17%). Which indicated that the 83% of the animals were had better wound healing with the use of staples the postoperative wound complications and discharge were minimal and these findings were in accordance with [11, 21]. The postoperative suture site infection was less which was correlating with [9]. Healing without any wound dehiscence was noticed in five cases (83%) and in case of IB (11%) alone showed wound dehiscence on the 7th day postoperatively. The absence of wound dehiscence indicated that staples were having better tissue holding capacity than sutures [10]. Skin staples were relatively inert and can be left in situ for a longer period of time without any complications. The postoperative wound dehiscence was less 83% of animals and the similar findings were reported by [9, 11]. The minimal tissue reaction nature of the stapler allowed rapid wound closure, less damage with no wound dehiscence [10].The skin staples removed on the 10th postoperative day in all the animals [19] with staple remover, which was easy and painless [10] and well tolerated by the animals. In the present study, the suture line was dry, clean without any discharge and complete scar less wound healing noticed in five cases (83%) (Fig.7) and in one case moist, soiled suture line with discharge and wound dehiscence (Fig.8) was observed it can be due to improper post-operative care taken by the owner.

Staples facilitated the process of wound healing by closing dead space within the wound. They were found easy and quick to apply, produced better apposition of wound edges with less tissue trauma, reduced tissue compression, minimized cross hatching resulted in scarless wound healing. The wound complications like postoperative infection, pain, scarring and keloid formation were not noticed [21, 11, 10].The staples were removed easily with stapler remover which was less painful and animals showed uncomplicated complete scar less wound healing. Without any wound dehiscence, fistula formation and gaping of edges.

Fig 5: Skin wound was apposed with disposable stainless steel skin staples

Fig 6: On 7th postoperative day all the staples are intact with dry suture line

Fig 7: On 10th postoperative day all the staples were removed and complete healing noticed

Fig 8: On 10th postoperative day wound dehiscence noticed with the presence of fistula

Table 1: Animal Particulars (n=6)

Animal No	Breed	Age (Years)	Body weight (KGs)	Feeding Pattern	Stage of Lactation	Calving History (days)	Duration (Days)	Etiology	Udder morphology	Teat which affected	Shape of the affected teat	Length (cm)
IA	CBJ	7	260	Grazing	1	2	1	Barbed Wire	Bowl	LFT	Cylindrical	12.5
IB	CBJ	5	326	Stall fed	1	25	16	Thorn	Bowl	RHT	Cylindrical	5
IC	CBJ	7	256	Stall fed	1	9	11	Treaded	Pendulous	LHT	Funnel	6
ID	CBJ	4	240	Stall fed	1	9	11	Treaded	Pendulous	RHT	Funnel	5
IE	CBJ	3	290	Stall fed	1	30	20	Thorn	Bowl	RFT	Cylindrical	10
1F	CBJ	3	280	Stall fed	1	5	6	Treaded	Pendulous	LFT	Cylindrical	11

CBJ – Cross Bred Jersey, 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 10th postoperative day in animals group I (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	Suture removal day	Day of presentation	Suture removal day	Day of presentation	Suture removal day	Day of presentation	Suture removal day	Day of presentation	Suture removal day
I A	0	0.125	White	White	Normal	Normal	6	6.5	Negative	Negative	221176	268957
I B	0	0.060	White	White	Normal	Normal	7.5	7.5	Negative	Negative	389236	396175
I C	0	0.125	White	White	Normal	Normal	6.5	6.5	Negative	Negative	251800	291276
I D	0	0.190	White	White	Normal	Normal	6.5	6.5	Negative	Negative	286927	285912
I E	0	0.130	White	White	Normal	Normal	6	7	Negative	Negative	237564	329568
I F	0	0.115	White	White	Normal	Normal	7	7.5	Negative	Negative	349218	392510
Mean ± S.E.		0.1242 ± 0.017					6.59 ± 0.23	6.91 ± 0.20			289320.17 ±27268.27	327399.67 ±22668.47

Table 3: Morphological evaluation on 7th day (n=6)

Animal no	Intactness of staples	No. of staples		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
I A	Intact	18	18	Dry	Soiled	No	No
I B	Not Intact	8	5	Moist	Soiled	Yes	Yes
I C	Intact	15	15	Dry	Not Soiled	No	No
I D	Intact	9	9	Dry	Not Soiled	No	No
I E	Intact	7	7	Dry	Not Soiled	No	No
I F	Intact	12	12	Dry	Soiled	No	No
Mean ± S.E.		11.3 ± 1.76	10.8 ± 2.0				

4. Conclusion

Application of disposable skin staples on skin of teat was found to be economical, took less time to apply, good tissue holding capacity, very meagre tissue reaction, reduced number of dressings, easy to remove and favored early uncomplicated scarless wound healing. Removal of staples was easy with staple remover and well tolerated by the animals. The quality of milk and milkability reflected the

effectiveness of the technique in regaining the functional capacity of the teat postoperatively.

5. Acknowledgements
The authors are thankful to the Dean, Rajiv Gandhi Institute of Veterinary Education and Research, Pondicherry for the facilities provided to conduct the study.

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