

Comparative study of skin closure in dogs with polypropylene and polyglactin 910

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ABSTRACT

The primary purpose of tissue reconstruction is to connect separated wound edges. Proper selection of sutures helps achieve better results in skin surgery. Polypropylen (Prolene[®]) and polyglactin 910 (Vicryl rapid[®]) were observed and compared for use in veterinary skin surgery. The handling characteristics of Prolene[®] suture is less satisfactory than Vicryl rapid[®] suture because of the stiffness of the material. Vicryl rapid[®] has a better control of knotting than Prolene[®] due to the material. Stitches were removed 9 days after surgery. In dogs whose wounds were sutured with Vicryl rapid[®] the threads only have to be wiped away, or have already fallen off by themselves. Suturing which has to be done under tension, infected wounds and usual skin surgery in pets, require synthetic non-absorbable monofilament material such as Prolene[®]. Good tolerance and the fact that there is no need to remove stitches make Vicryl rapid[®] suture very interesting for veterinary skin surgery in wild and zoo animals, non-socialized pets and wounds under casts.

Key words: skin sutures, polypropylene, polyglactin 910, stitch removal

Introduction

The art of suturing wounds is essential for modern surgery. The search for new and improved suture materials began in Egypt (2000 B.C.) where they used linen to close wounds. Galen, circa 75 AD, was the first to experiment with catgut. In 1869, Lister

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developed the concepts of both impregnating chromic acid in catgut and sterilizing suture materials (GOLDENBERG, 1959). Halsted proclaimed the advantages of silk over catgut during the early part of this century and as a result silk became the most common suture material in surgical practice. For the last two decades, cutaneous surgery has increased in complexity in terms of suturing materials. Most surgical procedures finish with suturing which intends to join the edges of the wound. Suture materials should produce minimal tissue reaction (VARMA et al., 1981), primary wound healing, good cosmetic results and avoidance of scarring. The wound healing process can be affected by the amount of suture material used, the suture type, the suturing technique, and the amount of tension on the suture. The ideal suture is one that can be used under all circumstances in every operation. Such a suture should include high tensile strength, low tissue reactivity, ability to form secure knots, easy handling, elasticity, flexibility, low cost, and lack of package memory. To date, not one suture possesses all these attributes. Therefore, compromises must be made in selecting suture material. Suture materials may be classified according to their behaviour in tissue (absorbable or non-absorbable), structure (monofilament or multifilament), or their origin (synthetic, organic or metallic) (FOSSUM, 1997). The United States Pharmacopoeia defines absorbable sutures as those that lose their tensile strength in less than 60 days (BOOTHE, 1985). Some synthetic slow absorbable sutures of a new generation, such as Panacryl[®], can maintain its strength for more than 6 months after implantation beneath the skin surface (Ethicon Inc., 2001). Non-absorbable sutures are defined as a filamentous material which is appropriately resistant to the degradation mechanisms of living mammalian tissue. Although non-absorbable monofilament suture materials present advantages with regard to their tensile strength, resistance to contamination and biocompatibility with living tissues, they are difficult to handle, especially during suturing and knotting, because of their rigidity (PEACOCK, 1984). The other drawbacks are potential risk of sinus formation and high degree of memory.

The use of monofilament non-absorbable suture materials is common in skin surgery. One such is polypropylene (Prolene[®]; Ethicon Inc. Somerville, NJ) formed by the polymerization of propylene by means of a catalyst. It is an extremely inert suture with high tensile strength, although is especially noted for its plasticity (BENNETT, 1988). Elasticity and plasticity are important terms in suture description. Elasticity refers to a suture's intrinsic ability to retain its original form and length after being stretched. Elasticity is a desirable feature, since it allows the suture to expand during wound oedema without causing strangulation or cutting of tissue, and to recoil during wound retraction, thereby maintaining wound edge apposition. Plasticity refers to a material that expands when stretched but which has a decreased tendency to return to its initial length when the deforming strain is no longer present. Hence, during regression of wound oedema, the suture may become loose and wound edges apposition is compromised (MOY et al., 1992). Polypropylene stretches to accommodate wound oedema, but remains loose when wound

oedema recedes (MOY et al., 1991). A slippery material with low adherence to tissue, allows this suture to be withdrawn easily from wounds (FREEMAN et al., 1970).

Polyglactin 910 (Vicryl rapid[®], Ethicon Inc. Somerville, NJ) is a relatively new, rapid absorption synthetic multifilament skin suture material (KNOTE and BOHMERT, 1996). This suture is copolymer of lactide and glycolide with a lower molecular weight than Vicryl suture, manufactured with a coating of Polyglactin 370 and calcium stearate. This lubricant coating gives Vicryl excellent handling and smooth tying properties (MOY et al., 1991). It offers several advantages because of rapid elimination from the body. Vicryl rapid[®] suture is particularly well-suited for skin closure and closure of lacerations under casts because the suture begins to “fall off” in 7-10 days as the wound heals. The removal of skin sutures, which remains a traditional event after many surgical procedures, is feared by animals, especially wild animals and non-socialized pets. The use of a rapid absorbing material, making that step unnecessary, as much for animals’ comfort as for economic consideration. The economic advantages are that there is no need for sterile instruments, possible costs of sedation or anaesthesia (wild animals). Before advocating widespread use of this material, however, it is necessary to show that it was well tolerated by the animal’s organism and that cosmetic results were satisfactory in comparison to monofilament non-absorbable sutures.

Materials and methods

The experimental part of the research was performed on 12 male beagle breed dogs, with an age range of 14 to 15 months (average age 14.5 months) and weighing 10.5 to 12.0 kg (average 11.2 kg). The animals were kept in separate cages at room temperature (20 °C) in natural light, fed with a standard veterinary pellet diet (Eukanuba[®], Iams, Iowa), with drinking water *ad libitum*. The animals were housed at the Clinic of Surgery, Orthopaedy and Ophthalmology, Faculty of Veterinary Medicine, University of Zagreb, where the surgical procedures were carried out.

The animals were randomly divided in two groups of 6 dogs: group A animals, whose experimental skin wound was closed with polypropylene (Prolene[®], Ethicon) non-absorbable monofilament suture, and group B animals, whose skin wound was closed with polyglactin 910 (Vicryl rapid[®], Ethicon) synthetic rapid absorbable suture. The experimental patients were assessed preoperatively and prepared for the operation in the usual manner.

Pre-medication was achieved by intramuscular application (dorsal aspect of the m. quadriceps femoris) of acepromazine (Sedalina[®], Chassot, Swiss) in doses of 0.05 mg/kg. Twenty-five minutes after the application of sedative, anaesthesia was induced with ketamine-chlorid (Narketan[®], Chasot, Swiss) in doses of 10 mg/kg and maintained with halothane and oxygen administrated in a closed system. Intravenous antibiotic in doses of 20 mg/kg (Klavocin[®], Pliva, Croatia) were injected in the time of induction.

The sites of incision were at the dorsal aspect of left ante brachium, in order to observe possible signs of irritation and “need for licking”. In the both experimental groups under anaesthesia, 7-cm skin wounds were made with a scalpel blade (No.15).

The suture material was determined by random assignment. Wounds were sutured in simple interrupted manner with either polypropylene (Prolene[®], Ethicon) or polyglactin 910 (Vicryl rapid[®], Ethicon) diameter 4-0 (U.S. Pharmacopoeia) armed with a circular cutting needle. All sutures were placed 0.5 mm from skin edge and 1 cm apart. Sutures were tied using a Mayo-Hegar needle holder. With precise positioning, the sutures were tied with sufficient tension to loosely approximate wound edges and bring skin into apposition. A double square knot was made in the usual manner. Care was taken to ensure that for all throws tension on the ears was equal and opposite in direction. The ears, the cut ends of knot, were cut to a length of 4-5 mm.

During the suturing three handling characteristics were evaluated and noted in protocol for each dog; precision of knot tying, square knot positioning and resistance of knot slippage. Each characteristic was rated on a scale of 1 = poor to 5 = excellent by three general surgeons.

Differences between the two groups of dogs for each handling characteristic were statistically tested. Probability $P < 0.05$ was considered statistically significant.

All dressings were removed 24 hours after suturing and the incisions were clinically inspected by surgeons thereafter. Evidence of postoperative swelling, signs of licking and irritation, signs of local inflammation and wound dehiscence were observed and registered on days 1, 3, 5 and 9 postoperatively, when the stitches were removed.

Results were compared to a previously conducted study in veterinary and human medicine to determine the handling characteristics and tissue reaction benefits of polyglactin 910 (Vicryl rapid[®], Ethicon) in veterinary skin surgery, and compared with classic non-absorbable monofilament material for skin closure (polypropylene- Prolene[®], Ethicon). The possible advantages of no stitch removal of Vicryl rapid[®] suture were also observed.

Results and discussion

In Table 1 is shown the distribution of credit for the most significant intra-operative performance of Vicryl rapid[®] and Prolene[®] sutures. It is significant that both Vicryl rapid[®] and Prolene[®] are most often marked with grades 4 and 5.

Vicryl rapid[®] is marked with grade 3 only once, and Prolene[®] twice. Vicryl rapid[®] has a better precision of knot tying than Prolene[®]. The average grade for Vicryl rapid[®] is 4.5 and for Prolene[®] 3.83 (difference is significant: $P < 0.05$). Our results agreed with previous reports regarding easier handling of Vicryl rapid[®] compared to Prolene[®], which makes suturing quicker and easier.

Table 1. Distribution of credit for “handling” of suture materials Vicryl rapid® and Prolene®

| Vicryl rapid® | | | | | | |
|-----------------------------|-------------------|-------|---|---|---|---|
| Characteristic | Number of samples | Grade | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| Precision of knot tying | 6 | | | | 3 | 3 |
| Square knot positioning | 6 | | | | 3 | 3 |
| Resistance of knot slippage | 6 | | | | 3 | 3 |
| Prolene® | | | | | | |
| Characteristic | Number of samples | Grade | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| Precision of knot tying | 6 | | | 1 | 5 | |
| Square knot positioning | 6 | | | 1 | 2 | 3 |
| Resistance of knot slippage | 6 | | | | 1 | 5 |

Square-knot positioning with Vicryl rapid® has an average grade of 4.5, and Prolene® 4.3. Resistance of knot slippage by Prolene® was marked 4.8, and Vicryl rapid® 4.5, which agreed with conclusions in previous reports (ROSIN and ROBINSON, 1989).

There were no complications, such as irritation and dehiscence of wounds (Table 2) sutured either with Vicryl rapid® or Prolene®. Postoperative swelling was noticed in 5 dogs (83.3%), whose wounds were sutured with Vicryl rapid®, and in 6 dogs (100%) whose wounds were sutured with Prolene®.

Inflammation was noticed in 5 dogs (83.3%), whose wounds were sutured with Prolene®, and in 4 dogs (66.7%), whose wounds were sutured with Vicryl rapid®.

Swelling was noticed in two animals two days after suturing with Vicryl rapid® and in one animal sutured with Prolene®.

Table 2. Post operative complications whose wounds were sutured with Vicryl rapid® and Prolene®

| Complications | Number of samples | Suture materials | |
|------------------------|-------------------|------------------|----------|
| | | Vicryl rapid® | Prolene® |
| Postoperative swelling | 6 | 5 | 6 |
| Licking and irritation | 6 | 0 | 0 |
| Inflammation | 6 | 4 | 5 |
| Wound dehiscence | 6 | 0 | 0 |

Frequency of inflammation two and five days after suturing is shown in Fig. 1. Inflammation was noticed in 4 animals sutured with Vicryl rapid® and in 5 animals sutured with Prolene®. The same frequency of inflammation was noticed on the fifth day after operation.

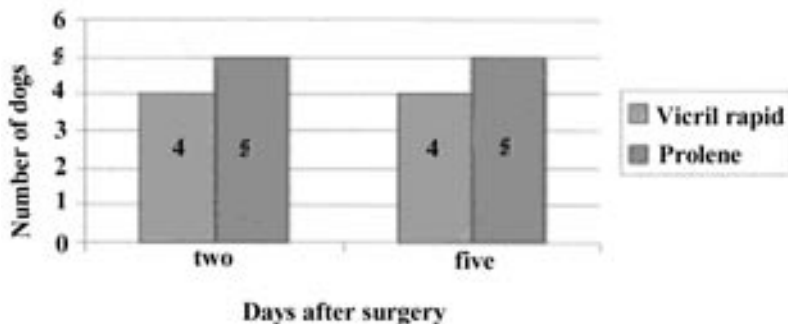


Fig. 1. Number of dogs with inflammation second and fifth day after suturing with Vicryl rapid® and Prolene®

Stitches were removed 9 days after surgery. The mean duration of stitch removal in wounds sutured with polypropylene was 4 minutes, requiring two to three medical personnel, a suture removal kit and gauze pads. In dogs whose wounds were sutured with polyglactin 910 (Vicryl rapid®), the threads only have to be wiped away or had already fallen off by themselves.

This is the first part of a clinical study to be conducted in order to evaluate the intra-operative and post-operative performance of rapid absorbable suture material (Vicryl rapid®) in skin surgery in dogs.

It is clear that the objective of suturing is to place multiple layers of tissues in close contact so that a minimal quantity of new connective tissue will be required to restore structural integrity of the tissue in the shortest possible time. The handling characteristics of surgical sutures are one of the most important considerations in suture selection (FAULKNER et al., 1996).

This study confirms that polyglactin 910 (Vicryl rapid®) is very interesting for skin closure in veterinary medicine and is associated with good tolerance and cosmetic results. In none of the wounds was any disturbance of the healing of the wound observed post-operatively that was caused by the Vicryl rapid® suture material used. The principal advantage is that no stitch removal is required, which is especially important for temporary wound support in non-socialized pets, wild and zoo animals, wounds under casts and situations with economic considerations. Our results are in accordance with previous clinical studies using this suture material in human medicine for wound closure in paediatric surgery

(CANARELLI et al., 1988; MARTELLI et al., 1994). Suturing which has to be carried out under tension, infected wounds and usual skin surgery in pets, require synthetic non-absorbable monofilament material, such as an extremely inert polypropylene suture.

Conclusion

In conclusion, results obtained with Vicryle rapid® sutures are comparable to those obtained with non-absorbable sutures in elective surgery. Good tolerance and cosmetic results, as well as the fact that there are no stitches to be removed, make Vicryl rapid® a first choice in the aforementioned situations for skin closure in veterinary skin surgery.

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SAŽETAK

Primarna svrha rekonstrukcije tkiva je spojiti odvojene rubove rane. Pravilan izbor materijala za šivanje pomaže u postizanju boljih rezultata u kirurgiji. Prolene® i Vicryl rapid® istraženi su glede njihove upotrebe u veterinarskoj kirurgiji u svrhu šivanja kože. Prolene® se pokazao lošijim od Vicryl rapid® materijala zbog tvrdoće. Nit Vicryl rapida® se može bolje kontrolirati pri vezanju čvorova. Šavovi su uklonjeni devetog dana nakon šivanja. U pasa čije rane su rekonstruirane materijalom Vicryl rapid® šavovi su bili izvađeni povlačenjem ili su sami otpali. Šivanje rana s napetošću okolnog tkiva, inficiranih rana i uobičajenih rekonstrukcija u kirurgiji malih životinja zahtijeva sintetički neresorptivni jednonitni materijal kao što je Prolene®. Dobra podnošljivost i činjenica da nema potrebe za vađenjem šavova čini Vicryl rapid® vrlo dobrim izborom za rekonstrukcije kože u veterinarskoj kirurgiji u životinja u zoološkim vrtovima, divljih životinja, kućnih ljubimaca agresivnog ponašanja te rana pod imobilizacijskim povojem.

Ključne riječi: kožni šavovi, polipropilen, poliglaktin 910, vađenje šavova
