

Subcuticular catgut versus polyglactin 910 in scar formation in sheep

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ABSTRACT: The aim of this double blind prospective experimental study was to compare the influence of polyglactin 910 (Vicryl, Ethycon) and plain catgut (Softcat-Plein, Braun) as subcuticular tissue sutures on wound healing and scar formation in sheep. Scar excision together with the surrounding tissue was made three months later. Scars were compared visually, photographed and examined under a light microscope. All scars were cosmetically acceptable, linearly hardly visible, aplanated and less than 1 mm in width with no difference between the parts in which plain catgut or polyglactin 910 were used. All photographs were examined by a plastic surgeon as well as by a dermatologist and they confirmed that all scars were cosmetically acceptable, hardly visible, aplanated and less than 1 mm in width. During the light microscopic examination done by the dermatologist foreign body granulomas were found in two scars where the subcuticular plain catgut was used. Concerning the plain catgut as an animal and foreign body granuloma inductor, the use of polyglactin 910 seems to be better.

Keywords: subcuticular; catgut; polyglactin 910; wound; scar

Wound healing and scar formation is influenced by a variety of endogenous and exogenous factors. Every surgeon tries to use the best suture material for the patient in given circumstances. Suture choice is based on personal experience, manufacturer's advice and scientific observations.

A large number of suture materials have emerged in the last fifty years that differ in physical and biological properties. A new era dawned in 1968 with introduction of polyglycolic acid (Dexon, Davis & Geck Co.) suture, the first synthetic absorbable suture, soon followed by polyglactin 910 (Vicryl, Ethycon) which is the most widely used suture material today.

The aim of our study was to evaluate the effect of different suture materials used as subcuticular sutures on wound healing and scar formation in sheep. The main objective of this study is scar as thin and cosmetically acceptable as possible. Elliot and Mahaffey (1989) showed a considerably smaller distension of scar when the skin was supported by subcuticular sutures, particularly in the phase of maximum scar distension. Distension of scar was finished after six months (Sommerlad and Creasey, 1978).

Longer subcuticular support by Vicryl (2–3 weeks) in comparison with plain catgut (7–10 days) should result in a thinner and cosmetically more acceptable scar in the part where Vicryl was used. There is a hypothesis that the use of plain catgut would result in many complications because of its animal origin (Wainstein *et al.*, 1997).

Regarding the utmost result of scar formation, this study may influence the selection of subcuticular tissue suture in human medicine.

There are only several reports that studied the influence of suture material (polyglactin 910 and plain catgut) on scar formation and inflammation (Driscoll *et al.*, 1982; Schoenberger *et al.*, 1985; Miro *et al.*, 1995; Wainstein *et al.*, 1997). Unfortunately, there have not been many experimental prospective double blind studies to compare suture materials and their influence on scar formation.

MATERIAL AND METHODS

Research was conducted on ten head of sheep. All procedures were carried out by one surgeon. After shaving, the gluteal region of the skin was prepared

with 1% ceramide (Cetavlon, Pliva) and 10% polyvidon iodide solution (Braunol 2000, Braun). After skin preparation, the skin was covered with sterile drape and anaesthetised with 5 mL of 0.5% bupivacaine chloride (Anekain, Pliva). A six centimetres long incision was made with scalpel down to the fascia. The incision was then closed by using single inverted 3–0 plain catgut subcutaneous sutures to close the cranial half and single inverted 3–0 subcutaneous polyglactin 910 sutures to close the caudal half of the wound. Plain catgut is a gut filament of natural origin, monofilament and resorptive. It supports the wound up to ten days. Polyglactin 910 is produced by polymerisation. Polymers were made by dragging on from hot amber and embarking in wreaths of different sizes. The main tissue reaction to these sutures is an excursion of macrophages from the interstitial space. Vycril is a resorptive, synthetic and monofilament suture with wound support for two to three weeks.

The epidermal skin was closed with a continuous intradermal 3–0 polyamide 6 suture on a reverse cutting needle, and covered with sterile dressing.

Skin suture was removed after 14 days. All wounds healed primarily. Two surgeons blinded for the method of wound closing examined and described the wounds concerning colour, width and hypertrophy. Primary healing was attributed 0 points and secondary healing 2 points. We considered 0 points as a good result and 2 points as a bad result.

After three months all scars were excised in local anaesthesia together with the surrounding tissue of an average size 7×1 cm and average thickness 0.7 cm. Excised scars were examined visually, photographed and examined using a light microscope.

Two surgeons not engaged in wound closure made visual examinations.

A plastic surgeon as well as a dermatologist examined the photographs of all excised scars. They evaluated the scars concerning colour and width of scars (Table 1).

We considered 0–1 points as an excellent result, 2–3 points as a satisfactory result and 4–6 points as a bad result.

Four samples for microscopic examinations were taken from each scar. A sample was taken from the part of the scar in which subcuticular plain catgut was used and from the part of the normal surrounding tissue. Other two samples were taken from the side of the scar when subcuticular polyglactin 910 was used and from the normal surrounding tissue. All samples were fixated in formaldehyde and stained with haematoxyline-eosin and acidic orceine. Microscopic changes in epidermis and dermis were evaluated by a dermatologist including the differences in the thickness of epidermis, amount of skin adnexa and amount of elastin fibres. Neither measurements of collagen type I /III ratio as a predictor of tissue strength nor analysis of total scar collagen has been made.

RESULTS

All wounds healed primarily and 14 days after surgery there were no differences in colour, width or elevation between the part of the scar where plain catgut was used in comparison with the part of the scar where polyglactin 910 was used.

The evaluation of the scars three months after the operation in the operated sheep revealed no differences in scar coloration and width comparing the cranial and caudal part of the scar. Both surgeons that evaluated the scars found no difference between the cranial and caudal part of excised scars. All scars were cosmetically acceptable, hardly visible, aplanated and below 1 mm width (Figure 1).

Neither plastic surgeon nor dermatologist found any difference in the cranial and caudal part of scars.

Concerning the fact that there were no differences between the numerical analysis of scars 14 days and

Table 1. Examination of the colour and width of scar

| Colour of scar | Points | Scar width | Points |
|-------------------------|--------|----------------|--------|
| Darker | 1 | less than 1 mm | 0 |
| Lighter | 1 | 1–1.5 mm | 1 |
| Red | 2 | 1.5–2 mm | 2 |
| Like surrounding tissue | 0 | 2–3 mm | 3 |
| | | more than 3 mm | 4 |



Figure 1. Scar appearance after 3 months

3 months after the surgery, the statistical analysis was not essential.

Microscopic examinations of the part of the scar sutured subcutaneously with polyglactin 910 showed a reduction in the amount of hair follicles in the epidermis and dermis while the amount of sebaceous glands was the same as in the normal surrounding skin. In this part of the scar the collagen fibres were not uniformly oriented as in normal skin. In three tissue samples perivascular mononuclear infiltration around blood vessels was observed. In the same tissue samples stained with orceine a reduction in elastin fibres throughout the dermis was noted. Only a small amount of elastin fibres oriented horizontally was seen in the upper third of dermis. In the deep layers of dermis there were no elastin fibres present within the scar nor within the normal skin.

The microscopic analysis of the part of the scar subcutaneously sutured with plain catgut showed granulomatous inflammatory reaction (foreign body granuloma) in the deep layer of dermis in two cases.

The other changes observed microscopically were the same as those observed in scars subcuticularly sutured with polyglactin 910.

DISCUSSION

Many surgeons are convinced that the use of different sutures affects scar formation and remodeling. In the past non-absorbable sutures were used. Occasionally they required surgical removal due to mechanical irritation or foreign body reaction (Peacock, 1984).

The aim of subcuticular sutures is to reduce wound tension, to obliterate dead space and to support the wound after epidermal sutures are removed (Christopher *et al.*, 1997). With appearance of slow resorptive materials there is an idea that these

materials would minimise scar widening, but there is no experimental or clinical data supporting such hypothesis. We conducted this experimental study to find out whether the type of subcuticular tissue has any influence in scar formation.

For experimental research many authors used other animals such as mice, pigs, rabbits or dogs (Driscoll *et al.*, 1982; Schoenenberger *et al.*, 1985; Miro *et al.*, 1995; Wainstein *et al.*, 1997). Sheep's skin is very similar to human skin and that is the main reason why we used sheep as experimental animals (Bacha and Bacha, 2000).

Miro *et al.* (1995) evaluated the wound breaking strength and healing after suturing uninjured tissues in mice. Silk sutures, polypropylene sutures and polyglactin 910 sutures were compared. The breaking strength for polyglactin 910 sutures was smaller than for polypropylene sutures.

Schoenenberger *et al.* (1985) treated blunt injuries of kidney in 12 pigs with polyglactin mesh and catgut sutures. There were fewer adhesions; less kidney scarification and less kidney atrophy if the polyglactin 910 mesh was used.

Driscoll *et al.* (1982) evaluated the uterus tissue reaction in rabbits using absorbable and nonabsorbable microsutures (nylon and coated polyglactin 910) and reported that after 35–70 days there was a lesser tissue reaction if absorbable sutures were used (Driscoll *et al.*, 1982).

Wainstein *et al.* (1997) compared the influence of suture material on pyeloplasty in rabbits. They noted that the most marked inflammatory reaction was produced by chromic catgut while the least reaction was evoked by polyglycolic acid and polydioxanone suture.

Handling of polyglactin 910 suture is more acceptable to most surgeons than catgut, but it is a subjective rather than objective remark (Guyuron and Vaughan, 1996). Polyglactin 910 is nonpyrogenic and nonantigenic and there is a minimal tissue reaction during resorption (Guyuron and Vaughan, 1996).

Some authors suggest the potential of gut suture as a soft tissue substitute to improve linear skin contour deficits (Liu *et al.*, 1997). Outlaw *et al.* (1998) showed an increased diameter of chromic catgut and multifilament sutures that was attributed to the infiltration of inflammatory tissue which has an impact on breaking strength. Compared with catgut, polyglactin was associated with less pain in the first three days and less need for analgesia but there was no difference in long-term pain (Kettle and Johanson, 2000). Gabrieli *et al.* (2001) showed in 1 000 plastic surgery outpatients that wound length, patient's sex and age, location of wound and surgical experience were primary factors that induce postoperative wound complications (i.e. tissue reactivity, infection rate, and wound dehiscence) rather than the factors related to suture materials and different surgical techniques.

In our research we observed by the microscopic analysis that there were more inflammatory reactions (foreign body granulomas) with catgut, but there was not any difference in wound healing and scar formation nor in the cosmetic result.

Since there was not any difference in scar formation between subcuticular plain catgut and polyglactin 910 sutures, as for the inflammatory reaction further studies should clarify if there is any difference in the inflammatory reaction in humans.

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