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COMPARISON OF POLYDIOXANONE AND POLYGLYCOLIC ACID SUTURES FOR CLOSURE OF ARTHROTOMY INCISIONS IN DONKEYS

(With 6 Figures)

By

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(Received at 23/12/1989)

مقارنة إستخدام خيوط البولى ديكسانون وخيوط حمض البولى جليكوليك في عمليات فتح المفاصل في الحمير

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تم عمل فتح لمفصلى الرمانة في القائمتين الأماميتين في عدد خمسة حمير ـ تم قفل محفظة المفصل والنسيج تحت الجلدى بإستخدام خيوط البولى ديكسانون في أحد المفصلين وإستخدام خيوط حمض البولى جليوليك في المفصل الآخر · تمت مقارنة وتقييم نتائج إستخدام هذين النوعين من الخيوط من ناحية قدرتهما على قفل محفظة المفصل حتى تمام الإلتئام ومن ناحية التفاعلات المختلفة لأنسجة المفصل بالنسبة لكليهما · بالنسبة لقفل المفصل حتى تمام الإلتئام ، وجد أن خيوط البولى ديكسانون مساوية لخيوط حمض البولى جليكوليك ، ووجد إستخدام خيوط حمض البولى جليكوليك يسبب تفاعلات أكثر في الأنسجة عنه في حالة إستخدام البولىديكسانون وحيث أن عمليات فتح المفاصل تحتاج إستخدام خيوط قادرة على قفل المفصل حتى يتم الإلتئام وفي نفس الوقت تسبب أقل قدر ممكن من تفاعلات الأنسجة معها ، فننصح بإستخدام خيوط البولى ديكسانون بالنسبة لهذا النوع من العمليات ·

SUMMARY

Arthrotomy incision was made on both front fetlock joints of five donkeys. The joint capsule and subcutaneous tissue were closed with polydioxanone suture material (PDS) in one joint and sutured with polyglycolic acid suture material (dexon) in the other joint. The materials were compared and evaluated for security of closure until healing was completed as well as the various tissue responses. Polydioxanone suture was related equal to polyglycolic acid for security of closure. The latter evocked greater tissue responses, when compared with polydioxanone suture.

Because of the requirments of suture to retain its strength while exciting a minimal amount of scar tissue during healing, PDS seemed a good. choice for closure of arthrotomy incisions.

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INTRODUCTION

The tissue of the equine joint capsule is bradytrophic, or slow to heal. CANNON (1969) reported that the degree of healing in 14 days after surgery ranged from complete healing to almost none in surgically incised equine fetlock joints. Equine joints heal with formation of dense scar tissue that may lead to joint stiffness and a decrease in the range of motion (MITCHELL and BLACKWELL, 1968). The ideal suture material for use in capsular tissue would have these characteristics: minimal inflammatory and foreign body reaction, yet able to maintain strength for a sufficient period to keep wound edges together untile healing is complete (CANNON, 1969).

Polyglycolic acid exhibit a duration of maximum tensile strength which is twice that of other absorbable sutures (BERRY et al., 1981). It is slowly absorped and excite a very low foreign body reaction when placed in subcuticular or muscular tissue (ANSCOMBE et al., 1970). Polydioxonone is a more recently developed polymer of para-dioxanone that can be converted into a flexable monofilament, suitable for all sizes of suture material. Clinical tests have showen polydioxanone to be useful in a variety of tissues and procedures (Ray et al., 1981).

The aim of this study is to compare polydioxanone (PDS) a synthetic absorpable suture material with polyglycolic acid (Dexon) for use in donkeys arthrotomies. The materials were compared and evaluated for security of closure as well as the micromorphologic evaluation of the various tissue responses.

MATERIAL and METHODS

Five healthy donkeys, ranging in age from 3-5 years, were used. Arthrotomy incisions were made in both front fetlock joints of each donkeys. The operations were performed under the effect of deep chloral hydrate narcosis, following premedication with i.m. injection of combelen (0.25 mg/Kg. B.W.). In each animal, 2-0 polydioxanone suture (PDS: Ethicon) was used for closure of the joint capsule and subcutaneous tissues of the right front fetlock joint (Group I, n= 5). 2-0 polyglycolic acid (Dexon: Davis & Geck) was used for closure of the joint capsule andsubcutaneous tissues of the left front fetlock joint (Group II, n= 5).

The donkey was placed in lateral recumbency, Esmarch's tourniquet was applied below the carpal joint. The animal was prepared for aseptic surgery of both front fetlock joints. A skin incision approximately 5 cm. long was made 1 cm. medial to the common digital extensor tendon over the fetlock joint. The subcutaneous fascia was incised along the same line as the skin incision. The incision was continued deep through the joint capsule. In both joints, the fibrous joint capsules were closed with horizontal mattres sutures. The tourniquet was removed and the small bleeders in the sucutaneous tissue were stopped. The subcutaneous tissues were closed with simple continuous pattern. An interrupted pattern was used to close the skin.

The wounds were covered with nonadherent dresings and bandages which were changed at 5, 10 and 15 days post-surgery.

On days 7, 14, 21, 28 and 35 after surgery one donkey was humanely euthanized and the appearance of the wound evaluated. Tissues from the incision site ot the joint capsule were harvested and submitted for histopathological evaluation.

The tissue speciemens were fixed in neutral buffered formaline and prepared by the conventional techniques for microscopic examination.

RESULTS

Gross observation of healing of the arthrotomy incisions of both front fetlock joints revealed that there was incomplete healing at 7 days. Wound dehiscence, local heat, swelling and lameness associated with septic arthritis were not evident. By 14 days the healing was completed. In group I there was complete satisfactory healing of the incisions with minimal tissue thickening at 21, 28 and 35 days. In group II, the examination revealed the presence of minimal joint distention and discernible soft tissue thickening at the surgical sites. This thickening was most prominent on days 21, 28 and 35.

One week post-surgery, the joint capsule sutured with PDS showed focal areas of necrosis at the wound edges. Between the necrosed edges, partially absorbed blood clot and few aggregations of neutrophils were observed. At the same time, an early granulation tissue formation was commensed at the vascularization sites of the tendenious part of the joint capsule (Fig. 1). Such granulation tissue was composed mainly of newly formed capillaries and few fibroblast cells. The acute inflammatory phenomenon appeared in the form of few neutrophilic and lymphocytic aggregates. Apart from the area of granulation, the other collagenous tissue of the joint capsule appeared oedematous and showed few haemorrhages as well as lymphocytic infiltrates.

After 2 weeks, an advanced granulation tissue expressed by highly proliferated fibroblasts, increased fibrous elements and decreased vascularity could be noticed at the incision site (Fig. 2). At 3 weeks, such granulation tissue transformed into mature collagenous bundles and fibrocytic cells. However at the wound edges, it showed areas of myxomatous degeneration (Fig. 3). On the other hand, the suture material was invaded by mononuclear cellular infiltrates and proliferated giant cells. Such process resulted in partial lysis and absorption of the suture material (Fig. 4).

After 4 weeks, some suture material appeared surrounded by healthy mature fibrous tissue at one side, while the other side was encircled by the original collagen bundles of the joint capsule. Apart from the stitches, the wound incision healed through granulation tissue formation which closed the wound edges. At 5th week, the majority of the suture material was absorbed and healing occurred by mature fibrous tissue.

Microscopic observations of the jont capsule sutured with Dexon, one week post-surgery, didn't differ from that sutured with PDS. However, few eosinophilic infiltrations could be found at the site of granulation tissue formation.

Fig. (1): Early granulation tissue formation. (PDS, one week, H&E, X 160).

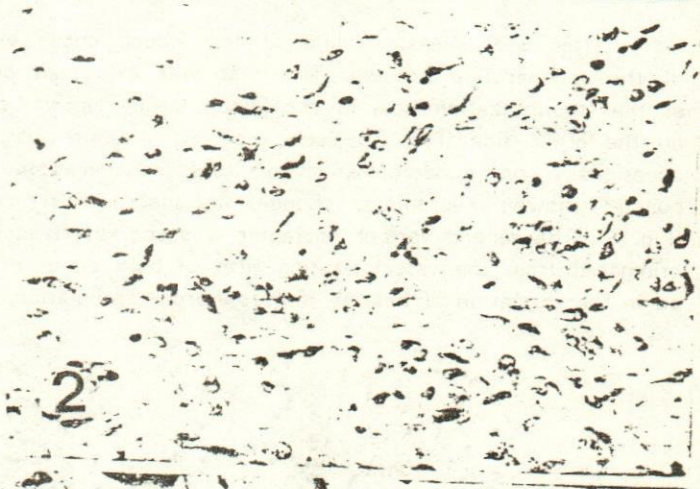

Fig. (2): Advanced granulation tissue (PDS, 2 weeks, H&E, X 400).

Fig. (3): Myxomatous degeneration of the granulation tissue (PDS, 2 weeks, H&E, X 400).

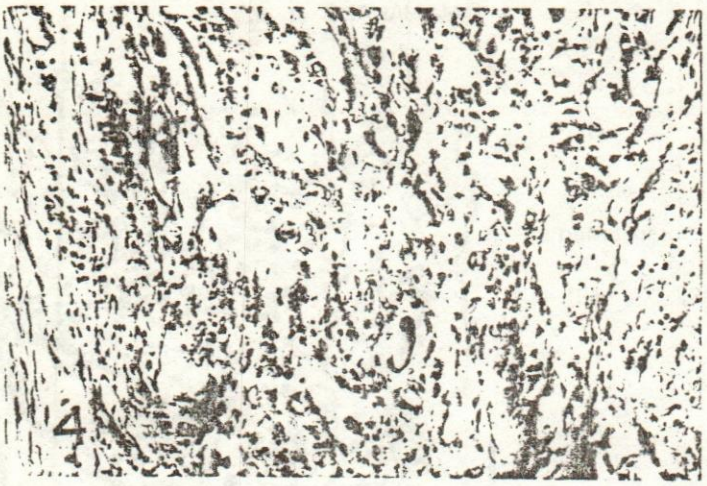

Fig. (4): Partial lysis and absorption of the suture material (PDS, 3 weeks, H&E,X250).

After 2-3 weeks, healing of the wound edges exhibited two variable patterns of the regenerative process. The first was expressed by granulation tissue formation at the vascularization sites of the joint capsule opposite to the original collagen bundles on the other side (Fig. 5). Such granulation tissue showed retardation in growth and occasionally had undergone myxomatous degeneration. In addition, the collagenous bundles showed necrobiotic changes associated with mononuclear cellular infiltration (Fig. 6). The second variant of repair was characterized by granulation tissue formation originated from the vascularization sites of both edges of the wound incision. It resulted in the formation of healthy mature fibrous granulation tissue.

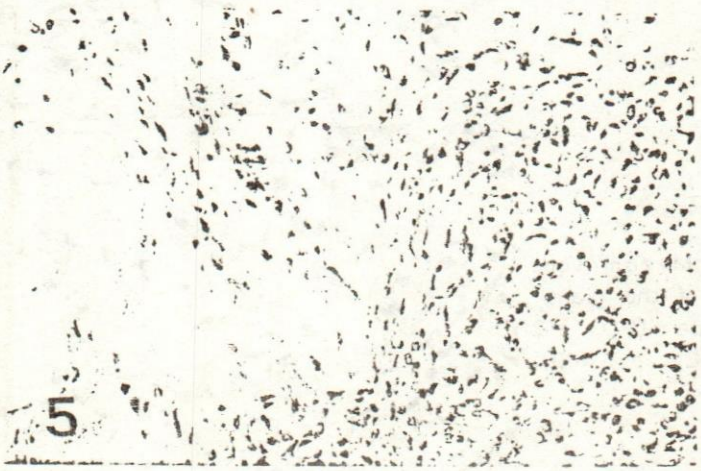

Fig. (5): Wound edges healed by granulation tissue at one side and collagen at the other (Dexon, 3 weeks H&E, X 250).

Fig. (6): Suture material surrounded by dense fibrous connective tissue capsule (Dexon, 5 weeks, H&E, X 65).

On evaluation of the tissue response to Dexon material at 3-5 weeks post-surgery, the common picture of tissue reaction to suture material was characterized by unabsorption of the stitches together with granulation tissue formation. The majority of the examined cases showed encircling of the stitches by a mature fibrous connective tissue (Fig. 6). However, in some cases, the suture material was surrounded by retarded granulation tissue from one side and collagenous bundles from the other dside (Fig. 7). In such cases, the collagenous bundles appeared necrotic and were associated with inflammatory cellular reaction (Fig. 8).

Fig. (7): Suture material surrounded by retarded granulation and degenerated collagen (Dexon, 3 weeks, H&E, X 160).

Fig. (8): Necrobiotic changes of the collagen bundles (Dexon, 3 weeks, H&E, X 400).

DISCUSSION

Fetlock joint is one of the most mobile joints in the equine skeletal system and the resultant movements and stress play a role in the capsular wound disruption (CANNON, 1969).

In the prsent study, although the clinical evaluation of the arthrotomized joints revealed complete healing at 14 days, the hsito-anatomical nature of the joint capsule influenced the regenerative process. In both PDS and Dexon-treated groups, healing of the joint capsule took place by granulation tissue formation. Similar results were recorded by LERWICK (1983), MALNATI & STONE (1983), JOCHEN & SWITES (1984), and CHUSAK & DIBBELL (1983). Such granulation tissue originated from the vascularization sites of the joint collagen. It was obvious that, the occasional presence of these sites opposite to each other approximated the wound edges and healing was perfect. Otherwise, the formed granulation tissue adjoined to the original collagen bundles ofthe joint capsule.

The present work showed that PDS induced an acute inflammatory reaction which supervened to subacute at the 3rd week. Such subacute macrophagal reaction resulted in partial lysis and absorbtion of the suture material. At the 4th week, regeneration of the joint capsule was completed by mature fibrous connective tissue formation.

In the Dexon sutured joints, the inflammatory tissue response failed to lyse and absorbe the sutures, so, healing was retarded. ANSCOMBE (1970), BERRY (1981) and KIRBY et al. (1989) considered that the smooth contour of the monofilament suture material play a role in the healing process. In our findings, such probability seemed of no importance. In the Dexon-sutured group, the formed granulation was retarded in growth and the joint collagen showed myxomatous degeneration. Such changes may be attributed to the persistence of the suture material which acted as a chronic traumatic irritant to the joint capsule.

In conclusion, the fate and effect of Dexon material was quite different from PDS. PDS seemed a good choice for wound regeneration and is recommended for suturing of joints.

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