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EFFECT OF *ALOE VERA* GEL ON EXPERIMANTAL TENDON HEALING IN DONKEYS

E. R. Al-Kennany [1], A. H. Allawi [2], Z. T. Abd-Almaseeh [2]
[1]Department of Veterinary Pathology, [2]Department of Surgery and Obstetrics, College of Veterinary Medicine, University of Mosul, Mosul, Iraq

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ABSTRACT

This study was conducted to explore the effect of *Aloe vera* gel on healing of experimentally incised superficial digital flexor tendon in donkeys. Results of this study showed that healing of severed tendon in all experimental animals was through proliferation of fibroblasts and angioblasts and collagen fibers formation, and also presences of newly oriented tendenous tissue like the original tissue in 21 days postoperatively for the animals treated with *Aloe vera* gel, while this tissue never seen in control group for same period. As well as notice of mature irregular granulation tissue which was still poorly oriented in control group within 21 days postoperatively, whereas the animals in group treated with *Aloe vera* gel showed mature regular (organized) granulation tissue within 14 days postoperatively. This study proved that *Aloe vera* gel has ability to accelerated tendon healing through prevent wound infection and protect the tissues from contamination.

تأثيرهلام نبات الصبار على التئام الأوتار تجريبياً في الحمير

إنتصار رحيم الكناني[1]، أسماء حسين علاوي[2]، زياد طارق عبدالمسيح[2]
[1]فرع الأمراض البيطرية، [2]فرع الجراحة والتوليد، كلية الطب البيطري، جامعة الموصل، الموصل، العراق

الخلاصة

صممت هذه الدراسة لمعرفة تأثيرهلام نبات الصبار على اصلاح القطع المحدث تجريبياً في الوتر القابض الإصبعي السطحي في الحمير. اظهرت نتائج هذه الدراسة ان التئام الوتر في جميع حيوانات التجربة كان من خلال تكاثر الاورمات الليفية والاورمات الوعائية و تكوين الألياف الغراويه، وقد لوحظ وجود نسيج وتر متعظي جديد مشابه للنسيج الأصلي في اليوم ٢١ في المجموعة المعاملة بهلام نبات الصبار في حين لم يشاهد مثل هذا النسيج عند مجموعة السيطرة لنفس الفترة، كما شوهد نسيج حبيبي ناضج لكنه غير منتظم في مجموعة السيطرة عند الفترة ٢١ يوم بينما في مجموعة الحيوانات المعاملة بهلام نبات الصبار لوحظ في الفترة ١٤ يوم ان النسيج الحبيبي كان ناضج ومنتظم.

أثبتت نتائج هذه الدراسة على ان لهلام نبات الصبار قابلية في الإسراع من عملية اصلاح الوتر من خلال التقليل من خمج الجروح والمحافظة على الأنسجة من التلوث.

INTRODUCTION

The natural history of repair of tendons and other dense connective tissues remain poorly understood, creating a deficiency in rationale for therapeutic intervention. However it is well known that as apart of the repair process of damaged tissue is replaced with cells and newly formed extra cellular matrices of connective tissue (1).

Tendon healing is a complex process in which inflammation and proliferation occur to form an intact tissue resembling parent tissue (2). Many treatments regimes have been used to promote tendon healing such as laser therapy and electrical stimulation (3,4).

Recently in many laboratories plants, such as vegetable oils, *Mytrus communis, Potato peel, Lowsonia inermis* and also *Aloe vera* were used for treating wounds (5-10). *Aloe vera* is a unique plant known to man, used throughout history for treating ulcers, dermatoses, burns, protection of gastric mucosa, also use as anti-inflammatory and antimicrobial agent (11-15), and for healing skin wound because of its unusual function to accelerate the healing of injured surface and tissues (10,16,17).

Because that, the purpose of this study was to explore the effect of *Aloe vera* extract (gel) on accelerating the healing of tendon experimentally.

MATERIALS AND METHODS

Twelve healthy adult donkeys (8 males and 4 females), weighting (150-170 Kg) and aged (3-5 years) were used in this study. They were kept in the House of animals, College of Veterinary Medicine, University of Mosul in confined yard. Anesthesia was induced by Acetyl Promazine Hydrochloride 5% at a dose of (0.5mg/Kg.B.W.) intravenously as a premedication followed 10 minutes later by an intravenous administration of Chloral hydrate 10% at a dose of (5g/50Kg.B.W.).

The right fore limb of each animal was preparate for aseptic surgery and a longitudinal incision about (4-6 centimeters) was made in the skin and subcutaneous tissue over the junction of superficial and deep digital flexor tendon at the level of mid metacarpus. After separating the superficial tendon from the surrounding tissues, sharp transverse complete incision was made in the tendon and its sheath. The severed ends of the superficial flexor tendon was then approximated and sutured using (No.1) silk suture material by Bunell suture technique. After that the tendon sheath was sutured using cat gut suture material (No.1) by means of continuous suture technique.

The animals were then randomly assigned to two groups (6 for each) according to type of treatment as following:

1. Group1: tendon was treated by local application of (5 ml) sterile normal saline.
2. Group2: tendon was treated by local application of (5ml) *Aloe vera* gel (Lily of Desert Denton, Texas 76208).

After spreading of treatment, the skin was closed by using simple interrupted suture technique with (No.2) silk suture material, then the limb was immobilized using external fixation. On the fifth post operative day the immobilization casts were removed from the surgical limbs (3,4).

The clinical findings of experimental animals were recorded along the duration of study. The biopsies from the site of operation including the sutured tendon and skin were collected from the animals on days 7, 14 and 21. All

specimens were dehydrated, cleared, embedded in paraffin wax, sectioned at 4-6μ and were stained with Harris Haemetoxyline and Eosin (18).

RESULTS

The results of clinical study revealed that there was swelling and oedema at the site of operation which subsided in 3-5 days after operation in group 2, while it continued for 5-7 days in animals of group 1. Lameness was the main clinical sign during the study and extended for 10-15 days in animals of group 1, while animals in group 2 returned to normal movement in 7-10 days after surgery.

The gross pathological findings included slight degree of adhesion between the superficial flexor tendon and the surrounding tissue at the site of suturing in 14 and 21 days after surgery in group 2, while the adhesion was too much in group 1 during the same period after operation.

The histopathological results in group 1 which was treated with normal saline, healing of skin wound occurred via fibroplasia and epithelization at 7^{th} day post wounding. Mature fibrous tissue was filling the wound within 7 days. Healing of severed tendon was occurred by connective tissue (collagen fibers) replacement, at 7th day post wounding. Fibrin clot, polymorphonuclear cells (PMNs) and fibroblasts were seen in intertendenous gap, fibrins were arranged in parallel fashions to long axis of the tendon. Fibroplasia and angioplasia was seen in layers of tendon stumps, newly capillaries were formed and infiltrations of PMNs were seen at these sites. Adhesions were seen at this stage between the tendons and subcutaneous tissues. At 14^{th} days post wounding, fibroblast proliferation was seen in superficial layer of tendon stumps and in the intertendenous gap. Amount of collagen fibers together with fibroblasts were seen at the end of tendon stump intermingled with old collagen bundles (Figs.1& 2). On the 21 days post wounding the intertendenous gap was filled with mature granulation tissue, but this granulation tissue was still poorly oriented and could be easily recognized from the original tendon tissue. Suppuration also seen in some injured tendon.

In group 2 treated with *Aloe* vera gel, healing of tendon occurred in a similar pattern as mentioned above only on the 21 days post wounding the healing tissue was hard and difficult to cut grossly. Microscopically presence of newly oriented tendonous tissue was seen similarly to normal tendon. In all steps of healing there was no evidence of infection during the healing process (Figs. 3, 4 & 5), there was no evidence for (PMNs) in healing area, also there was development of cartilage in the healing tissue within the intertendenous gap treated with *Aloe vera* gel at 21 days post wounding.

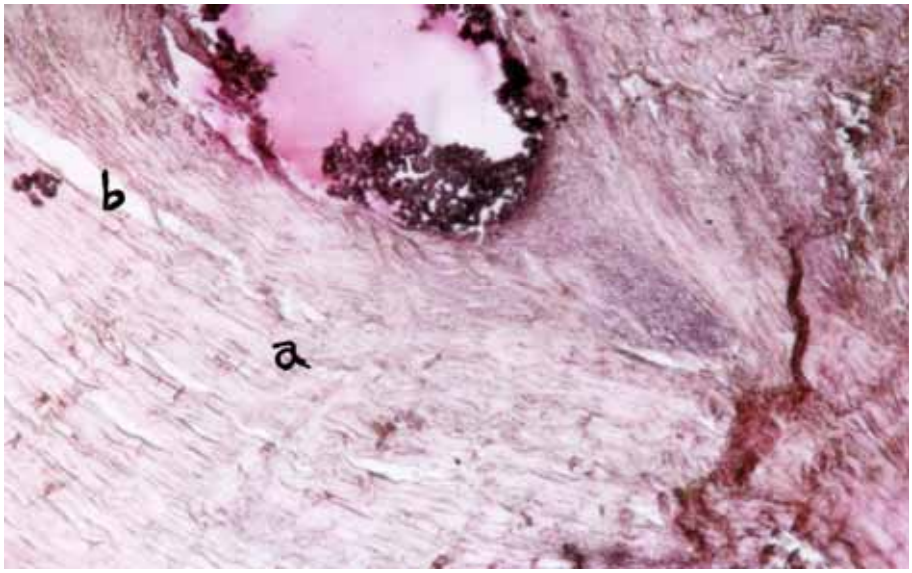

Fig. 1: Photomicrograph of healing tendon 7 days after tenotomy in group 1, showed presence of bundles of collagen fibers (a) surrounding the suture material with edema (b). H&E, 100 X.

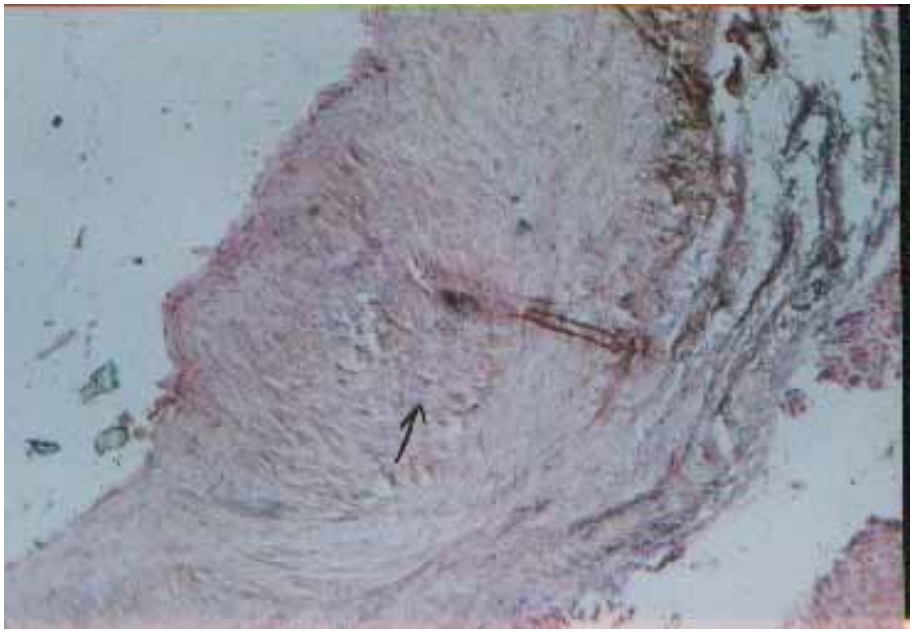

Fig. 2: Photomicrograph of healing tendon 14 days after tenotomy in group 1, showing fibroplasia and angioplasia (→) in area of incision. H&E, 100 X.

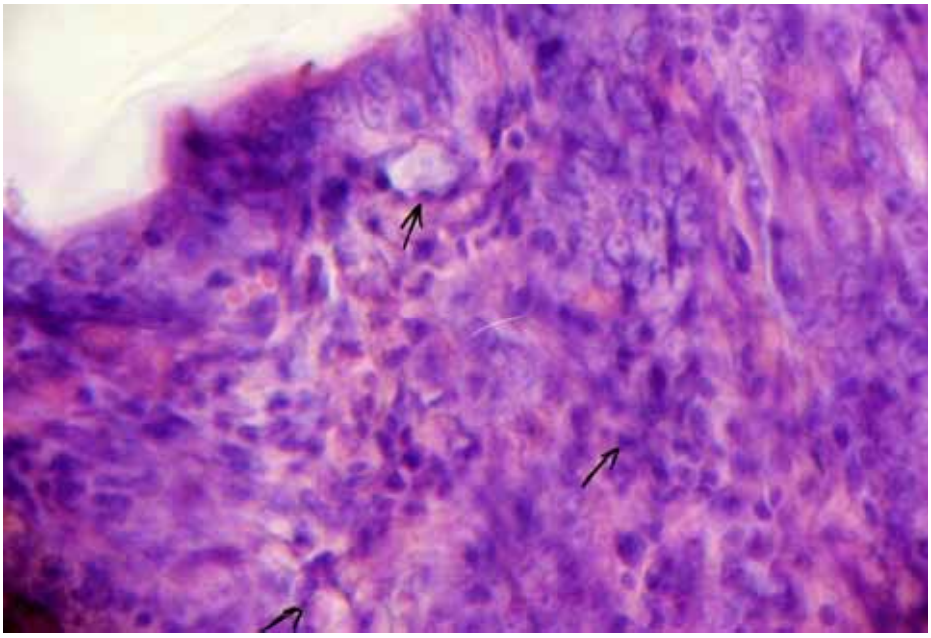

Fig. 3: Photomicrograph of healing tendon, in group 2 treated with *Aloe vera* gel 7days after tenotomy. Fibroblasts, angioblasts and newly formed capillaries visualized in the tendon stump (→). H&E, 200 X.

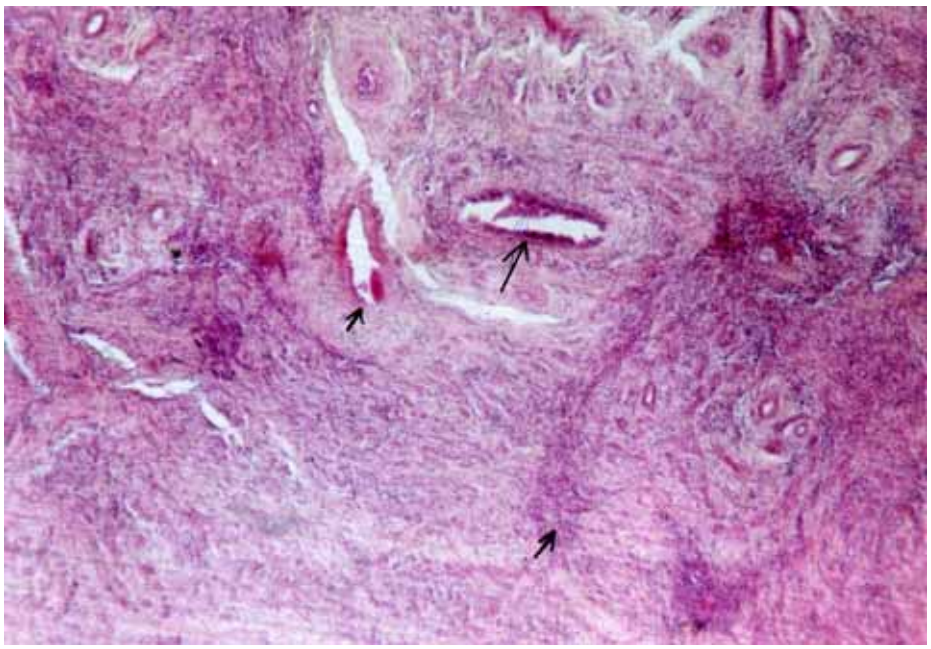

Fig.4: Photomicrograph of healing tendon, in group2 treated with *Aloe vera* gel 7 days after tenotomy. Notice proliferation of fibroblasts between bundles of collagen fibers associated with newly formed blood vessels (→) is evident within the intertendenous gap. H&E, 200 X.

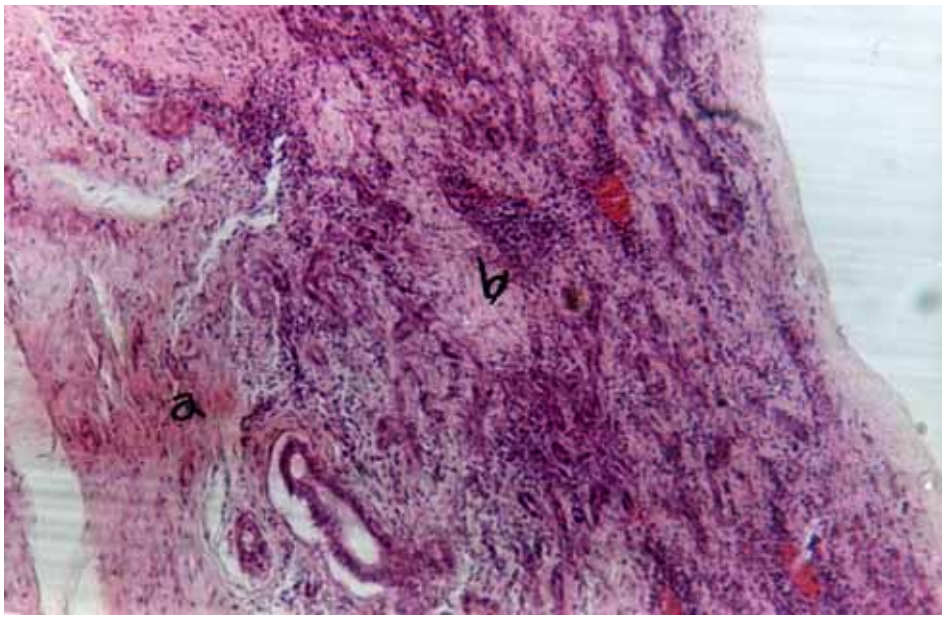

Fig.5: Photomicrograph of healing tendon, in group2 treated with *Aloe vera* gel 21 days after tenotomy. Showing the presence of proliferation of fibroblasts (a) and cartilage like cells between bundles of newly formed collagen fibers (b). H&E, 200 X.

DISCUSSION

This study has focused on the therapeutic efficacy of *Aloe vera* gel in accelerating wound healing of the tendons. Results of the present study indicated that healing of injured tendons occurred through fibroplasia in group1; and this result is in agreement with that described by other workers using other models of tendon repair (13-15). This study confirms the earlier observation that wound healing in the tendon is accelerated by local application of *Aloe vera* gel and this effect may be due to many chemical components, proteins, carbohydrate, vitamins and minerals, these components affect a multitude of a streng immune system.

Acceleration of tendon healing in the group treated with *Aloe* vera gel occurs due to ability for decrease of oedema and PMNs infiltration, and this explanation is in agreement with other workers (10). As well as due to Vit.C component of the plant, which induced collagen production, enhanced macrophage function, increases angiogenesis and functions as a powerful antioxidant. Also, *Aloe vera* may induce the fibroblasts to produce hyaluronic acid during the proliferative stage, which is the important part of the extra cellular matrix and one of the main glycosaminoglycan secreted in tissue repair.

The possibility that *Aloe vera* gel has significant potential as a biologically active vehicle for steroid in additional that have a growth factors cause masking the wound healing inhibitors. *Aloe vera* gel also improves wound healing, and inhibition of inflammation because it contain mannose-6-phosphate sugar which have anti-inflammatory activity and acceleration wound healing properties (10). *Aloe vera* gel stimulate fibroblasts for growth and repair of the synovial model because that, results revealed accelerate in healing at 21 days post wounding (10,17,19). Also, results of this study showed no infections have been seen may

be due to that *Aloe vera* gel has anti-inflammatory properties or antibacterial (20,21).

In conclusion this experimental study has shown that application of *Aloe vera* gel to tendon wound induced modulating effects leading to heal earlier. As the *Aloe vera* gel application for tendon wound is non irritant, non toxic as well as ability to stimulate proliferation of fibroblasts. Further studies are required to investigate the *Aloe vera* gel effect on other wounds facing animals during their life span.

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