قســـــــم : الجراحـــة والباثولوجيـــــا .
كليـــة الطـب البيطرى ـ جامعة أســـــيوط .
رؤساء الاقسام : أ . د محمود حسين الجندى ، أ . د . محمد ابراهيم الشرى .

دراسة تجريبية على التئام وتر أكيلـــس في الماعـــز

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أجريت دراسة تجريبية على التئام وتر أكيلس في عشـــرون ماعز محلي وشملت هذه الدراسة الأوتار المقطوعـــــة أو المزروعـــة .

وقد اثبتت النتائج أن التئام الأوتار يرجع الى تكويـــــن النسيج الضام ، وكذلك تكوين نسيج وتـــرى جديد .

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TENDON HEALING' EXPERIMENTAL STUDY ON SUTURED AND TRANSPLANTED TENODN IN GOATS

(With 9 Figs.)

By
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SUMMARY

Tendon healing and union was deacribed in twenty native breed goats. The mechanism of repair in both sutured and transplanted tendon was fully studied and discussed. It was clear that the process of tendon healing is due to proliferation and organization of connective tissue and also due to new tendinous tissue formation.

INTRODUCTION

Tendon diseases and injuries are common in all animals. Suturing of the ruptured Achillis tendon in animals other than ruminants recieved a great attention by many investigators(HICKMANN, 1942, ARMISTEAD, 1950 and EL-GUINDY, 1970).

Different surgical methods were performed for suturing the ruptured tendons using chromic catgut, silk, nylon or thin wire (MASSON and ALLEN, 1940, ANDERSON,1943, BERGE and WESTHUES, 1966 and EL-GUINDY, 1970). In some cases, tendon injuries are irriversible and transplantation is needed.

Study of the best methods for suturing ruptured Achillis tendon, tendon homoplasty and healing process in goats were the aim of the present work.

MATERIALS AND METHODS

This study was carried out on 20 native breed goats of different ages, sex and weight. The animals were divided into three groups. Group I, included 12 goats which were sub-divided into three subgroups according to the method of suturing used, Berge and westheus method, Mattress and Zepp method. Under complete aseptic techniques, the Achillis of one limb of all goats was severed. The two stumps of the divided tendon were then sutured aseptically with different types of suturing methods using silk. A plaster of paris bandage was performed. The plaster and suture were removed ten days latter and rebandaged for another two weeks. The animals were condemned two years after the operation.

Group II, included six animals and used for tendon transplantation, two goats were operated at the same time. A 3 cm segment of the Achillis tendon was removed from one goat and placed in a dish filled with sterile normal saline solution. The site of operation covered with a piece of sterile gauze soaked in saline soution. Another 3 cm segment of the Achillis tendon taken from the first animal was sutured in the limb of the second animal and vise versa using silk. Four goats were operated using double mattress sutures, one goat after the method ofBerge

silk. Four goats were operated using double mattress sutures, one goat after the method of Berge and Westheus and the other one with method after Zepp operation.

The Achillis tendon of the last two operations were ruptured (Fig. 1) and resutured with mattress sutures after 30 and 43 days from the first operation. The animals were condemend three years later. The operative field was carefully dissected, the tendon was exposed, examined, removed and photographed (Fig. 2).

Group III, included 2 goats which remained till the end of expriment as control animals.

Cross and longitudinal sections were taken from sutured areas, from grafted and from the normal tendon, fixed in 10% neutral buffered fromalin embedded in paraffin, sectioned, stained with Harries haematoxylin and eosin and Malory Heidenhan trichrome stain and examined. Sutured tendon as well as transplanted ones had been compared with that of controls.

RESULTS

The animals tolerated the operation well except two of them in which the transplanted tendons were ruptured. Resuturing was performed using mattress sutures. The animals could bear weight as the normal control ones. The method of Berge and Westheus was found to be the best in case of divided tendon and followed by complete repair. Mattress sutures were the optimal method for suturing the transplanted tendon while the other two methods failed to give support to the sutured tendon.

Microscopical Findings:

A- Sutured tendon:

All the specimens taken from these cases showed a process of a reparatory inflammation characterized by the presence of abundant connective tissue proliferation. The proliferative process seems to began from the edges or stumps of the cut and extending toward each other. By using Mallory trichrome stain, the connective tissue appeared to be consisted mainly of fibrous and cellular elements. The first was composed mainly of collagenous bundles which appeared to be relatively lesser in the tendinous scar when compared with the normal tendon structure or even with and area somewhat far from the seat of suturing. Furthermore the bundles appeared irregular in direction or to some extent not parallel to each other and the fibers were short and showed wavy courses.

The cellular elements consisted mainly of fibrocytes usually located inbetween and parallel to the fibrous element. In some areas the connective tissue showed myxomatous degenerative changes.

In the tendinous scar, and commonly in the most peripheral zone near the edge of the cut and in the middle zone, newly formed tendinous fasculae could be observed. Those fasculae are composed of C.T capsule (peritionum externum) surrounding a highly vascular connective tissue (Fig. 3).

Some fasculae to be divided by a septum which originated from the connective tissue capsule (Fig. 4). Inbetween the fasculae and encircling them loose connective tissue with many newly formed capillaries could be seen (Fig. 5). The reparatory tissue appeared more vascular than the normal tendon (Fig. 6), but the peripheral zone showed either competely obliterated vessels or even vessels with variable degrees of degenerative changes (Fig. 7). Most vessels showed medial fibronoid degeneration. Degenerative changes were also observed in the smooth

muscle cells which appeared greatly swollen and vacuolated. In some vessels adventitial proliferation could be also observed.

The suture material was surrounded by a dense fibrous connective tissue capsule which also extended inbetween and encircle the individual elements of the material (Fig. 8).

In specimens, in which Berge and Westheuse suturing method was used, there was less evidence of degenerative changes in the connective tissue scar as well as the alterative changes in the wall of blood vessels was less prominant vascular thrombosis was infrequent. The histoid arrangment of the connective tissue scar had a great resemblance to tendinous tissue.

In Mattress suturing method there were multiple areas of focal myxomatous degeneration and severe alterative vasculitis manifested in muscular vacuolation and fibrinoid degeneration. In Zepp suturing method most of the vessels showed thromobosis and the histoid arrangment of the scar was greatly disturbed.

B- Transplanted tendon:

Other then the ruptured cases which are not included, the transplanted tendon appeared more or less to be single monolithic cord along with the preexisting tendon. They were nearly of the same thickness, and apparently differed from the normal tendon with the exception of the presence of suture material used in some parts. No adhesion occurred between the transplanted tendon and the skin. The transplanted part could not be easily differeniated from the normal tendon and there were no distint bounderies between them.

Histologically, all the area of union between the tendon and the transplanted part, the blood supply of the transplanted part apparently extended from the preexisting ends of the sectioned tendon. The vascular network were observed mainly in the endotenonium and peritonium, the arrangement of the blood vessels appeared to have a branching character. The wall of the blood vessels was thickened and the adventitia showed proliferative source for the devlopment of granulation tissue. Few blood vessels manifested degenerative changes and organized thrombi in their lumnae. Most of the organized thrombi showed recanalization and rendothelialization. At the point of union extensive proliferation of highly vascular and poorly cellular connective (Fig. 9). The transplanted part showed some fasculae with necrotic changes (Fig. 10). The suture material was surrounded by connective tissue capsule.

DISCUSSION

Regeneration in tendon is efficient, but the process is slow. WALTER and ISRAIL (1979) stated that tendon ends should be accuretly united and under some tension otherwise union is by fibrous scar tissue. In our experiment, the method of Berge and Westhues was found to be the best for tendon repair in case of divided tendon, in which the histoid arrangment of the scar was regular and the alterative changes in both the scar and the blood vessels were minimal when compared with the other methods used. Mattress suture was optimal method for suturing the transplanted tendon, while the other two methods used failed to give support to the sutured tendon and specimens were not for histopathological examination.

Reliable healing process occurred in our materials could be attributed to the use silk as suture material as well as to the tension exerted by the usage of plaster of paris bandage.

In our experiment hyperplastic fibroplasia which was described by MASSON and ALLEN (1941), EL-ATRIBY and EL-GUINDY (1970) could be rarely observed, this could be assumed to the time duration between operation and sample taking.

The second stage of healing described by MASSON and ALLEN (1941) which is concerned with organization and differentiation of connective tissue was well expressed in our study. The origin of this connective tissue could be assumed to and arised mainly from the peritonium externum as well as the surrounding peritendious tissue (EL-ATRIBY and EL-GUINDY, 1970).

In addition, it was clear that the vascular adventitial proliforation provides a second and most important source of the proliferating connective tissue necessary for the process of healing and tendon union.

The multiplication of tendon cells produced new fibers in sutured tendon in order to join the cut ends. This probably originated from the prolifertion of the peritonium internum which whose cells lie in loose connective tissue and have abundant nuterient source and space necessary for multiplication (BUCK, 1953).

In our study, vascular degenerative changes as well as partial or complete occlusion of some blood vessels could be conaidered as a propable causeof necrosis of some fasculae.

Accordingly, we can conclude that, healing process of tendon is partially due to proliferation and organization of connective tissue and partially due to new tendinous tissue formation.

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LEGENDS

Fig. (1): A goat showing ruptured Achilis tendon.

Fig. (2): Showing : a) normal b) sutured, and c) transplanted tendons.

Fig. (3): Newly formed fasculi composed of connective tissue capsule surround a highly vascular connective tissue. (H. & E., X 100).

Fig. (4): A fasculi divided by septum which originated from the connective tissue capsule. (H. & E. X 100).

Fig. (5): Highly vascular connective tissue encircles the newly formed fasculi. (H. & E. X 4).

Fig. (6): Tendon showing highly vascular reparatory tissue. (H. & E. X 100).

Fig. (7): Blood vessel showing degenerative changes and its lumen is nearly obliterated. (H. & E. X 250).

Fig. (8): Tendon showing connective tissue encircling sutured material. (H. & E. X 100).

Fig. (9): Tendon showing fasculi with necrotic changes. (H. & E. X 250).

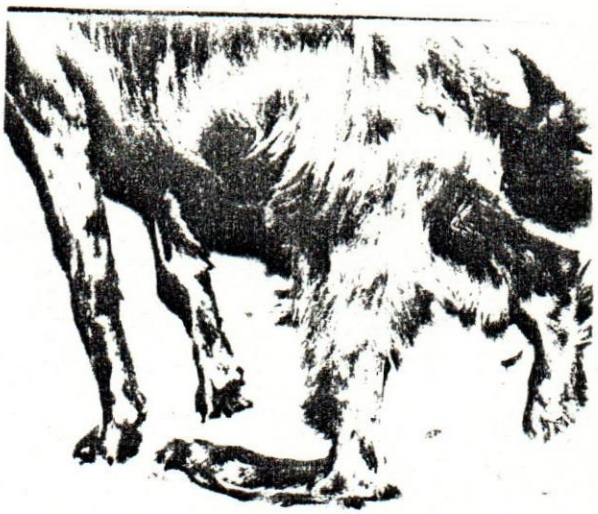

Fig. (1)

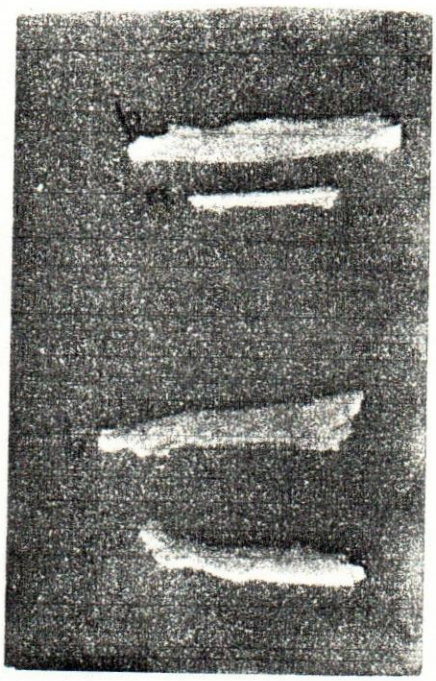

Fig. (2)

Fig. (3)

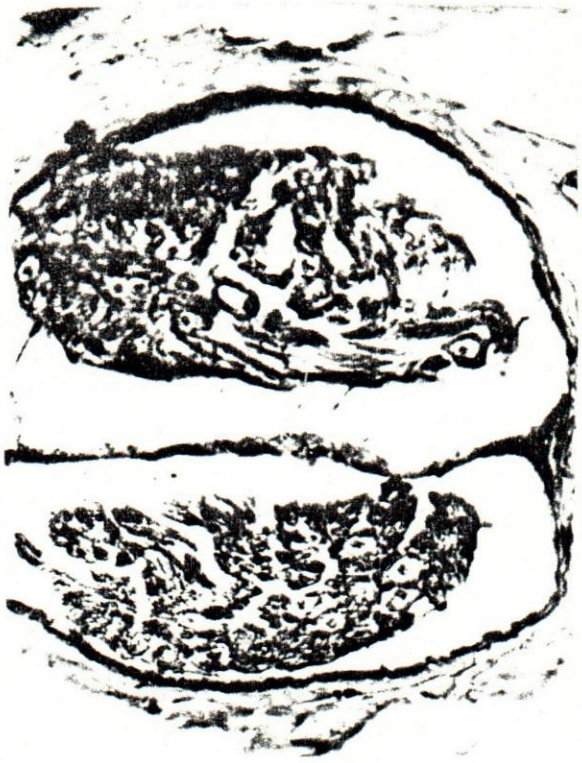

Fig. (4)

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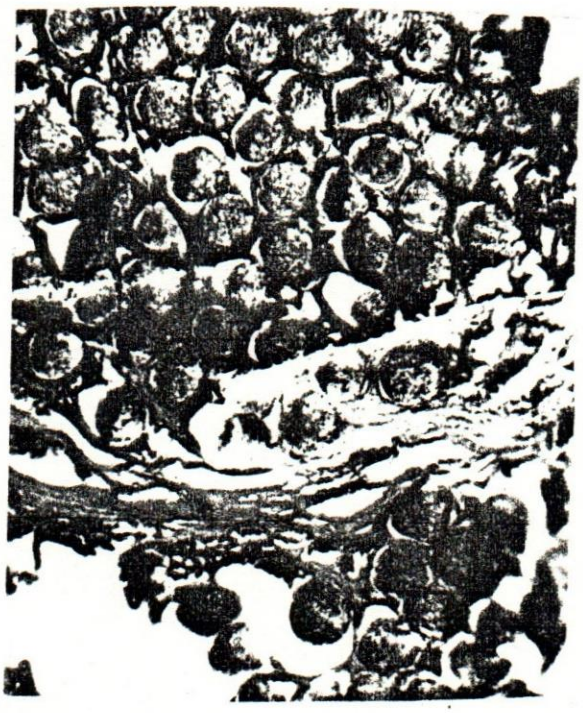

Fig. (8)

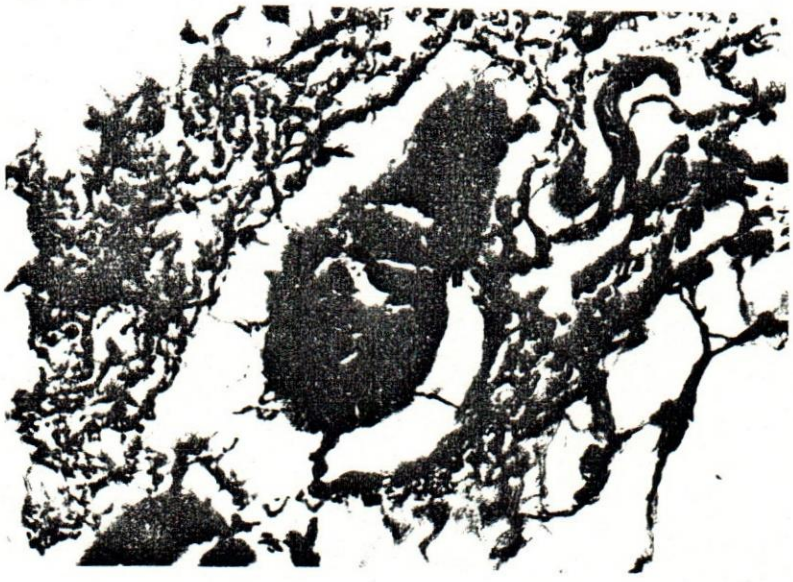

Fig. (9)