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EXTERNAL SKELETAL FIXATION FOR TENDON REPAIR IN EQUINES

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SUMMARY

Healing after tenorrhaphy of transected flexors in combination with external skeletal fixation of the metacarpophalangeal joint in 8 equine species (6 donkeys and 2 horses) was evaluated clinically, ultrasono-graphy and histologically for 3 months. The external skeletal fixation device was used to induce mild flexion of the metacarbophalangeal joint to the degree that keeping the apposition of the sutured tendon without tension until healing.

Key words:

Tendon, tenorrhaphy, external skeletal fixation, single locking suture

INTRODUCTION

Traumatic flexor tendon disruptions are a major problem in equids specially those exposing to mechanical damage by road accidents or wire cuts or by degenerative changes resulting from continued stress (Fackelman, 1973; Stromberg and Tufvesson, 1977).

Clinical evidence of flexor tendons injuries usually has variable degrees of locomotor dysfunction , signs of local inflammation, tendon disruption and dropping of the fetlock (Goodship et al., 1992; Barr et al., 1995; Gibson et al., 1997). Many clinical studies have been conducted on treatment of tendon injuries (McCullage et al., 1979; Valdez et al., 1980; Spurlock, 1989; Jann et al., 1990; Bertone et al., 1990; Taylor et al., 1995; Bertone, 1995;

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Eliashar et al., 2001; Reef, 2001). In spite of extensive research on the surgical management of tendon lacerations, many approaches of surgical treatment are sometimes frustrating and eventful giving great consideration to failure of the treated tendon tension. Therefore, the purpose of this work was to use skeletal transfixation device with an aim at providing the environment for healing of the sutured injured tendon without tension.

MATERIALS AND METHODS

Eight adult clinically healthy equine species (6 donkeys and 2 horses of mixed breeds) were used in this study. The experimental group comprised (4 donkeys and one horse) and the control group comprised (2 donkeys and one horse).

The animals were premedicated with i.v.xylazine(1.mg/Kg.bw) and Ketamine (2.0 mg/ kg.bw) and anaesthesia was induced with i.v. sodium thiopental (5.0 mg/kg.bw) and maintained with halothane and oxygen mixture by endotracheal intubation. The right metacarpal, fetlock and pastern regions were prepared for aseptic surgery. A tourniquet was placed above the carpus. An 8 cm (in horses) or 6 cm (in donkeys) long skin incision on the lateral surface of the mid-metacarpal region, over the flexors was made. The incision were continued through the subcutaneous tissue and paratenon to isolate the superficial and deep digital flexors tendon which was tenotomized. The tenotomized flexors were subjected to tenorrhaphy with single locking loop suture pattern using polygalactin 910 No.3. Tenorrhaphy was followed by the application of the external skeletal fixation device (ESF) in the experimental group only (4 donkeys and one horse) while the control group (2 donkeys and one horse) was subjected to tenorrhaphy only without ESF.

The used device comprised of 4 transfixation pins (two above and two under the fetlock) of 5mm diameter. A 1cm long skin incision was made on lateral side of the distal third of the metacarpal bone close to the fetlock joint. Blunt dissection with a hemostat was performed to expose a small area of bone. The used pin was fixed into the power drill and drilled through the first bone cortex using low speed drilling through a drill sleeve down the second cortex which was penetrated. As the pin emerged from the opposite side, an exit incision was made with the scalpel as soon as the pin begun to tent the skin. The pin was then emerged for an appreciable length from the opposite side of the limb i.e. transfixation through-and-through pin. The second pin was drilled 3cm from the first one at the same level.

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The third and fourth pins were similarly drilled in the mid-pastern region on the lateral side and parallel the previous pins inserted on the distal metacarpus. Normal saline was poured on the pin during drilling to reduce thermal necrosis. The paratenon was left unsutured. The surgical site was lavaged with sterile saline. The subcutaneous tissue was closed with continuous suture using polygalactin 910 No.1/0. The skin was closed with simple interrupted suture using silk No.1/0.. The percutaneous pins were connected on both sides with plastic tubes after leaving a distance of 4cm from the skin from both sides, in which the unhardened pin gripper methyl-acrylate resin was poured and left for 10 minutes for hardening while holding the fetlock joint in mild flexion position to allow repair of tenorrhaphy without undue tension. The operated sites were radiographed for confirmation of pins' alignment (Fig. 1). The pin tracts were covered with povidone iodine ointment and covered with sterile sponges. A bulky cotton and gauze wrap was applied around the pin from both sides. A hoof bandage with thick cotton pad was also applied. After care comprised injection of tetanus antitoxins 3000 IU, SC, phenylbutazone 2mg/kg.bw IM twice daily for 3 days and ampicillin 20mg/kg.bw IM twice daily for 7 days. The opposite unoperated limbs were kept in a support bandage. All animals were confined in their stable to restrict their activities for 3 weeks. Antiseptic dressing and bandage replacement were performed every 5 days. The skin stitches were removed after 10 days while the transkeletal pins were removed after 3 weeks and a support bandage was mainained for more 3 weeks. The animals were allowed up for hand walking and mild activities. The animals were followed clinically and ultrasonographically for 3 months. The animals were then euthanized and samples from the sutured tendons of the experimental and control groups were collected for histopathology.

RESULTS

The postoperative period was uncomplicated in most of animals of the experimental group, although one donkey had pin tracts sepsis with subsequent pin loosening after one week and was excluded by euthanasia. Two animals (one donkey and one horse) of the control group exhibited marked permanent lameness terminated with disruption of the sutured tendons by the third week P.O. The third animal of the control group (a donkey) showed painful palpable thickening of the operated tendon and remained recumbent for 2 weeks, terminated with euthanasia. Three of the animals of the experimental group showed pin sores after one week which healed satisfactorily

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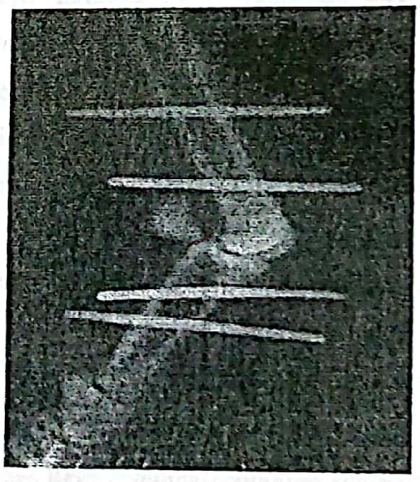
with frequent antiseptic dressings combined with administration of systemic antibiotic cefotriasonon 20.0 mg/kg.bw IM, twice daily for 7 days. After 3 weeks, when the transfixation pins were removed from the animals of the experimental group, the operated areas showed gradual and rapid decrease of local oedema and the animals presented mild lameness. By one month P.O., no abnormality of the gait during hand walking was noted. A slight palpable thickening of the operated tendons with pain could be elicited when pressure was applied to the tendons. By 2 months P.O., 6 of the experimental animals regained their normal gait while the other 2 animals were mildly lame at the trot. The ultrasonogrphic examination after the removal of the skeletal transfixation pins showed the incorporation of the suture material used in tenorrhaphy into the extensive fibrosis, demonstrated by areas of increased echogenicity. There were also some areas of decreased echogenicity, indicated reduced fiber alignment of the repaired tendon (Fig. 2) Although the operated tendons were not painful after 2 months P.O, ultrasonogram revealed some residual hypoechoic areas at the site of tenorrhaphy. Postmortem examination of the operated tendons after 3 months showed perfect coaptation of the severed tendons (Fig.3).The histopathological findings after 3 months P.O. showed mature scar reactions with vascular reorganization and tendoneal bundles are markedly improved with tenorrhaphy and skeletal transfixation immobilization (Fig.4).



(Fig.1) Latero-medial radiograph of the metacarpus and phalanges demonstrating placement of the external skeletal transfixation pins. Notice the mild flexion of the fetlock joint.

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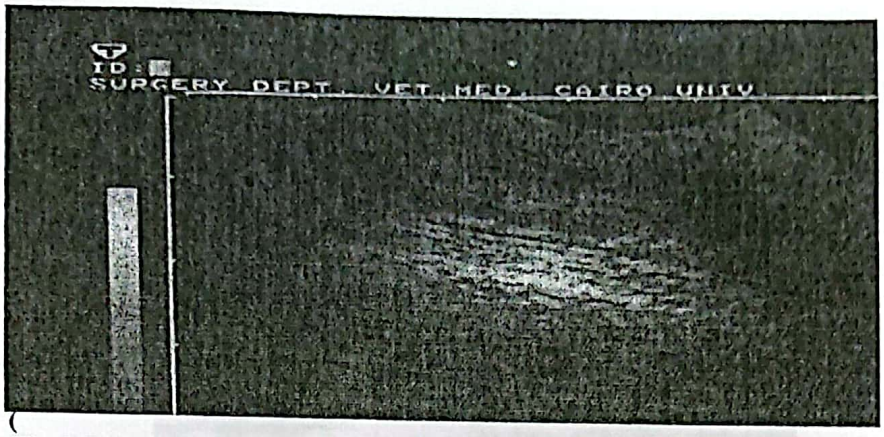
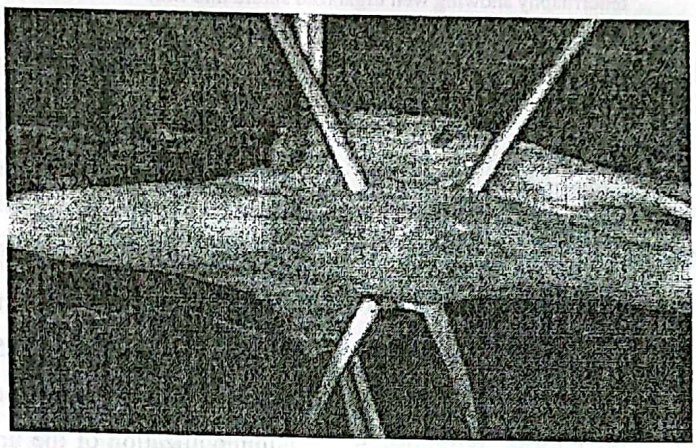


(Fig. 2) Follow-up ultrasonograph after 3 weeks post-tenorrhaphy shows hypoechoic residual areas of flexor tendons



(Fig. 3) Dissection of the proximal digital flexor region after 3 months post-tenorrhaphy demonstrating perfect coaptation of tendons

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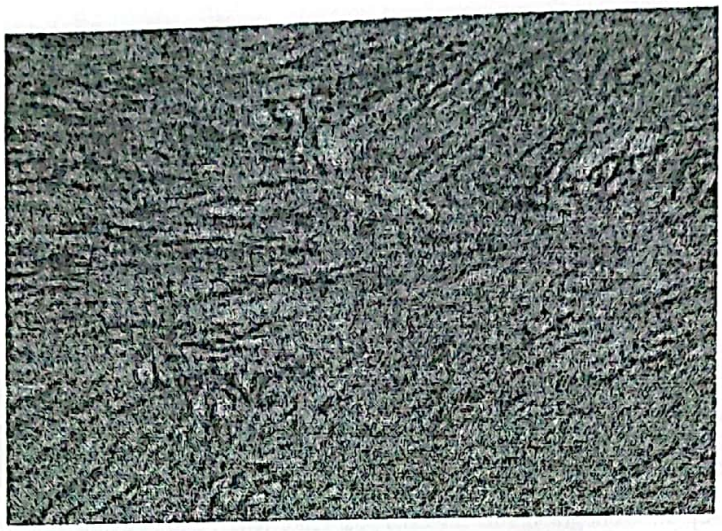

(Fig.4) Microphotograph of the tendons after 3 months post-tenorrhaphy showing well organized suture line with marked reduction in vessels and cells (HE. X 100)

DISCUSSION

Repair of the transected digital flexor tendons in equines was satisfactorily achieved by the combination of tenorrhaphy with single lockingloop suture pattern using the absorbable suture material polygalactine 910 and immobilization of the fetlock joint in a moderate degree of flexion by using transfixation skeletal device to allow primary repair without loading tension on the sutured tendon.

The concept of immobilization of the fetlock joint in a moderate degree of flexion to avoid early loading of the repaired tendon is consistent with the case report of (Crawford and Jaane, 1997) who placed the flexed fetlock in a cast to repair of a deep flexor digital flexor tendon deficit in a horse.

However, many investigators Spurlock, 1989; Jann et al., 1990; Easley et al., 1990; Foland et al., 1991; Janne et al., 1992; Bertone, 1995; Taylor et al., 1995; Eliashar et al., 2001) have treated severed tendons by suturing and immobilization of the limb in full extension by casts or splints with varying degrees of success and many complications might be encountered such as failure of suture material, tearing of tendon fibers, infection, wound dehiscence and restrictive adhesions.

Adopting the transfixation skeletal device, the encountered complications were limited to one case which had pin tract sepsis which could be avoided by strict asepsis,

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frequent asepticdressings and post-operative long systemic antibiotic course.

Removal of the transfixation pins was after 3 weeks P.O. This time was selected to compromise with the beginning of the maturation phase of tendon healing (Ketchum ,1979 and Watkins, 1992) or loosening of the fixation pin when stays for longer duration (Aron, 1984). Further, such early removal of the transfixation pins combined with starting mild hand walking, seems to correspond with the previous observation of (Ketchum et al., 1977) that immobilized injured tendons are weaker than those exercised under a controlled regime and healing tendon triples its tensile strength in just 2 weeks after mobilization. In this study, tenorrhaphy with the absorbable suture material polygala-ctin 910 No.4 resulted in well incorporation into the scar tissue. This result supports tenorrhaphy with absorbable suture (Jann et al, 1992 and Eliashar et al, 2001).

Tenorrhaphy with single locking loop pattern was satisfactory when used with the skeletal transfixation device to avoid tendon ischemia and to reduce the size of the scar. On the contrary, a nylon double locking loop suture pattern was preferred by (Bertone et al,1990) for flexor tenorrhaphy of a tendon gap. Ultrasonographic examination followed up after removal of the transfixation pins was very helpful and could demonstrate the incorporation of suture material into scar tissue after 2 months from tenorrhaphy. Similar findings were reported by (Eliashar et al., 2001 and Reef, 2001).

Histopathologic evaluation of the scar after 3 months from tenorrhaphy revealed the formation of a mature scar. This is in consistent with the findings of (Bertone et al., 1990 and Jann et al., 1992).

In conclusion, external skeletal transfixation device can be used satisfactorily for repair of flexor tendons after tenorrhaphy to ensure that the sutured tendon remains in apposition by placing the fetlock in a moderate degree of flexion and to avoid loading of the repaired tendon. Further studies need to be conducted to trace the value of using such device in unsutured tendons or tendon with gaps and tendon healing strength with different suture materials.

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التثبيت الخارجى الهيكلى لعلاج الأوتار فى الخيول

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استهدفت هذه الدراسة معرفة مدى أهمية التثبيت الخارجى الهيكلى لمفصل الرمانة على عملية الالتئام للأوتار القابضة لأصابع القوائم الأمامية.

أجريت هذه الدراسة على عدد 8 حيوانات من الفصيلة الخيلية(6 حمير و عدد 2 حصان). بعد إجراء عملية التخدير الكلى لهذه الحيوانات تم إحداث جرح قطعى جراحى للأوتار الأصبعية القابضة السطحية و العميقة للقائمة الأمامية اليمنى.

تم توصيل هذه الأوتار المقطوعة بإستخدام غرزة Looking Loop الفردية و خيط الفكريل. تم تثبيت مفصل الرمانة بإستخدام عدد 4 مسمار من مسامير التثبيت الخارجى الهيكلى (اثنين فوق المفصل فى عظمة المدفع الامامى و إثنين تحت المفصل فى الأصبع الأول) و تبعة بعد ذلك ثنى المفصل قليلاً قبل تثبيت المسامير خارجياً بإستخدام مادة الأكريل تمت متابعة الحالات لمدة ثلاثة أشهر متتالية بإجراء الفحص الإكلينيكى و بإستخدام الموجات فوق صوتية و بالفحص الهيستوبا ثولجى.

أثبتت نتائج الفحص الإكلينيكى و الفحص بالموجات فوق صوتية و نتائج الهيستوباثولوجى أن التثبيت الخارجى الهيكلى لمفصل الرمانة قد يساعد على الالتئام السريع للأوتار القابضة و ذلك من خلال تخفيف عملية الشد التى قد تنشأ عند استعمال الحيوانات لقوائمها عند السير.

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