Journal of Animal and Veterinary Advances 7 (3): 351-353, 2008
ISSN: 1680-5593

Histomorphologic Study of Repair of Tendon Gap by Autogenous Skin Transplant in Dog

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Abstract: Injuries to the tendon include large part of orthopedic activities in animals. Flexor tendons injuries can occur in a number of ways, most of them are trauma. The purpose of this study was to use the skin instead of tendon in cases of tendon gap in dogs via an *in-vivo* experimental study. Five Iranian adult indigenous mix dogs of both sexes were selected. The superficial digital flexor tendon of the left hind limb was exposed under general anesthesia and 3 cm of middle one third of tendon was cut and removed. Then a piece of the shaved skin of the surgical site of the same animal was cut and was replaced for the tendon gap by locking loop suture pattern. The tendon samples were collected from the site of operation on 21st postoperative day for histomorphological evaluation. Histomorphologic study showed transformation of skin structures to tendon by showing degeneration of hair follicles and sebaceous glands and development of fibrous structure. This study reviled that skin transplant could be useful in repair on tendon gaps.

Key words: Skin transplant, tendon graft, histomorphologic, dog

INTRODUCTION

Injuries to tendons and ligaments are extremely common and account for enormous associated societal costs. As a result, attention has recently focused on attempts at tissue regeneration rather than on tissue repair (Woo *et al*., 1998). Although, the understanding of the anatomy and biomechanics of Achilles tendon is improving and although a variety of therapeutic options have been described, the results of clinical studies are still conflicting (Barton *et al*., 1984, 1990; Clancy *et al*., 1983; Cross *et al*., 1984; Dandy *et al*., 1982; Dehghani *et al*., 2005, 2007; Fithian *et al*., 1992; Forslund *et al*., 2003; Fowler *et al*., 1987; Harner *et al*., 1995; Jaakkola *et al*., 2000; Kannus *et al*., 1991; Lee *et al*., 2000; Taniguchi *et al*., 2000).

Fascia lata has been used for repair Achilles tendon reconstructions (Coskunfirat *et al*., 2003; Lee *et al*., 2000). Allogenic tendon transplantation has been undertaken experimentally in chicken (Zhang *et al*., 2001). Hamstring tendon graft was used for anterior cruciate ligament reconstruction (Gordia *et al*., 2001). Artificial tendon has been transplanted in man (Dong *et al*., 1989). There is no report of use of autogenous skin transplant in tendon defects. Therefore, the purpose of this study was to use autogenous skin for repair of tendon gap in dogs.

MATERIALS AND METHODS

This study was conducted on 5 clinically healthy adult indigenous Iranian dogs of both sexes. All the animals were dewormed and vaccinated against rabies. Superficial digital flexor tendons (SDFT) in the distal third of tibial region of the hind limbs were prepared for aseptic surgery. The animals were sedated using acetylpromazine (0.1 mg kg^{-1}, Kla laboratoria, Belgian) intramuscularly. Anesthesia was inducted by injection of ketamine (10 mg kg^{-1}, Rotexmedica GMBH, Germany) intravenously following endotracheal intubation maintained by a mixture of halotane and oxygen. A 10 cm long skin incision on the medial surface of distal half of tibia was made. The superficial and deep fascias were bluntly dissected to have a good exposure of SDFT and DDFT. The SDFT was then separated bluntly from the DDFT. A 3 cm long segment of SDFT was transected. Both stumps of the tendon were held in place by the stay sutures with No.0

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polyamide. A piece of the surgically prepared skin (3 cm length and 1 cm wide) of the surgical site was then cut aseptically and sutured in the tendon gap by No.0 stainless steel suture material and locking-loop suture pattern.

The surgical site was lavaged by normal saline solution. The subcutaneous tissue in all the animals was sutured with 3-0 catgut by simple continuous pattern. The skin was closed with simple continuous pattern using polyamide No. 1 and the wound was painted with povidone-iodine solution and covered with a piece of sterile gauze.

The operated limbs were immobilized in a slightly flexed position to reduce tension on grafted tendon. The ampicilin (Nasr Co., Iran) was given intramuscularly at the rate of 22 mg kg^{-1} body weight twice a day for seven days. As well as flunexin meglomine (0.02 mg kg^{-1}, Razak Co., Iran) was administered intramuscularly twice daily for 3 days. The skin sutures were removed on the 10th post operative day. All the animals were confined in order to restrict their activity for 10 postoperative days. The splint was removed on 10th post operative day, further more the dogs were allowed to have limited walking.

On day 21, animals were sacrificed by thiopenthal (30 mg kg^{-1}) injection intravenously; the tendon-graft-tendon unit was then collected from the site of operation for histomorphological evaluation. The samples comprised 2 cm above the graft and 2 cm below the graft. The intanct samples were collected from SDFT of colateral limbs to be compared with tendon-graft-tendon units. Tissue sections were processed routinely; fixed in buffered formalin 10%, paraffine embedded, sectioned at 5 μm and stained with hematoxylin and eosin. There were 5 graft samples and 5 intact tendon samples for biomechanical tests and similar numbers for histopathological evaluation.

RESULTS

Histomorphological changes of tendon biopsy indicated; presence of low rate of inflammatory cells, high rate of keratinocytes, degenerating hair follicles as well as fibrose tissue around the graft, there is no periosteum formation and immature mesenchymal cells over the graft site. As well as, there was no dehestion or rupture at the junction of tendon and skin (Fig. 1).

There was no non-weight bearing lameness after splint removal on 10th post operative day, only mild lameness (grade I) was evident for 1 or 2 days after the splint was removed. There was no adhesion, edema, infection or inflammation.

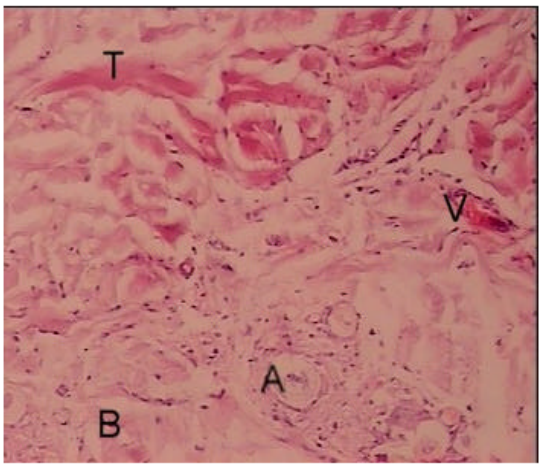

Fig. 1: Histomorphologic section of the tendon-graft-tendon unit (H and E X 60): note atretic hair follicle (A), fibroblasts (B), blood vessel (V) and tendon fibers (T)

DISCUSSION

One of the most encountered problems in dogs is disorder of locomotion. Injuries to the tendon include large part of orthopedic activities in animals. Different treatment techniques have been suggested for repair of tendon injuries. Many researches have been carried out on tendon auto-transplantation. Synthetic ligaments are occasionally used for particular tendon reconstruction, but natural materials are preferred for tendon reconstruction.

Oloumi *et al.* (2002) used greater omentum for repair of tendon defect. They observed high rate of inflammatory cells around the repair site.

Our data are in accordance with morphologic findings of some types of tendon transplantation previously reported (Wei *et al.*, 1988; Khatib *et al.*, 1996). Woo had suggested immobilization to improve tendon healing, also, Takai had mentioned limited physical activity after primary healing to improve tendon healing (Woo *et al.*, 1981; Takai *et al.*, 1991).

Collagen clusters appear 3 months after injury; attachments start to disappear in mature phase (Ketchum *et al.*, 1979). Complete and clinical tendon improving takes place 15 months after injury (Silver *et al.*, 1983). This study was conducted for 21 days to observe the feasibility of technique. For sure further study is needed for 90 days or even more to clarify effectiveness of skin for tendon reconstruction procedures.

CONCLUSION

The results of histomorphologic study showed partial transformation of skin structures to tendon by showing degeneration of hair follicle and sebaceous gland and development of fibrous structure without any rupture.

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