Primary Anterior Cruciate Ligament Reconstruction by Dacron Prosthesis Augmented with Iliotibial Band or Fascia Lata: A 14-year Subjective Outcome Study

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Purpose. A retrospective cohort study was conducted to evaluate the subjective long-term results of Dacron prosthetic ligaments in the management of primary anterior cruciate ligament reconstruction.

Methods. Sixty-four patients who underwent primary anterior cruciate ligament reconstruction with a Dacron prosthesis were followed for a mean of 10.9 years. Ligaments were reconstructed with a Dacron prosthesis augmented with either the iliotibial band or the fascia lata, using a modified Macintosh over-the-top technique. The subjective outcomes were evaluated by the Lysholm knee scoring scale, the Tegner activity scale and patient's satisfaction based on visual analog scale assessment.

Results. Dacron prostheses were removed within a mean interval of 4.5 years in 12 patients (19%). The mean overall Lysholm knee score was 81.4 and the mean Tegner activity rating scale was 5.3. More than 40% of patients had fair to poor outcomes and more than 45% reported being dissatisfied with the prosthesis at the most recent follow-up.

Conclusion. Prosthetic ligaments are still far from being perfect. Reconstruction with autologons graft remains the standard procedure for anterior cruciate ligament reconstruction.

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Key words

anterior cruciate reconstruction, Dacron prosthetic ligament

INTRODUCTION

Injuries to the anterior cruciate ligament (ACL) are common among athletes. Although the results of autogenous ACL reconstruction have been encouraging and are improving steadily, there are some disadvantages to the use of autogenous tissues, such as donor site morbidity and prolonged postoperative rehabilitation. Problems inherent with autogenous reconstructions have stimulated the search for prosthetic ligaments. [1] The strength of the Dacron prosthesis (3631 N), compared with ACL (1730N), makes it a reasonable alternative for ACL reconstruction.

Some animal [2-5] and human studies [6-8] have evaluated the effect of the Dacron prosthesis in ACL reconstruction of the knee. They have shown that Dacron ligaments are strong, reliable,

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and allow for potential fibrous and bony ingrowth. On the other hand, several investigators [8-10] have reported that the outcomes of ligaments reconstructed with a Dacron prosthesis were poor and the failure rate was unacceptably high. Comparable experiences with other prostheses have also been published [10-13], and all recommended that ligament prosthesis should be abandoned.

In the present study, we try to determine the subjective long-term results of Dacron prosthetic ligaments in the management of ACL reconstruction.

MATERIALS AND METHODS

We analyzed the results of 64 primary ACL reconstructions carried out with Dacron prostheses fron 1989 to 1993. The ACL in all patients was reconstructed with a Dacron prosthesis ligament augmented with either the iliotibial band or fascia lata, using a modified Macintosh over-the-top technique. Patients with multiple ligament injuries and patients who had undergone previous ACL reconstruction were excluded from the analysis.

The study subjects comprised 43 men and 21 women. The injuries that necessitated ACL reconstruction included traffic accidents (n = 17), non-pivoting, non-contact sports injuries (n = 4), pivoting, non-contact sport injuries (n = 38), contact sport injuries (n = 3) and work-related injuries (n = 2). The mean age at the time of operation was 27.5 years (range, 17-43 yr). Thirty-eight injuries involved the left knee and 26 the right. Thirty-five patients (55%) heard an audible pop at the time of original injury. A total of 19 patients (30%) had concomitant injuries, including lateral meniscus tears (n = 12) and medial meniscus tears (n = 7). All of the concomitant injuries were discovered at the time of reconstruction and managed with partial menisectomies. In general, all of our patients underwent reconstruction two weeks after initial injury, depending on the soft tissue condition. Four patients underwent surgery from two to four weeks after injury, 12 from four to 12 weeks, 25 from three to six months and the remaining 23 patients underwent ACL reconstruction six months after injury. All patients were fully informed about the potential risk, including foreign body reaction, and all patients made the choice between the Dacron prosthesis and autologous graft procedures.

All of the surgical procedures were done with a modified MacIntosh over-the-top method [14] and augmented with either the iliotibial band or fascia lata (Figure). In none of the cases was the Dacron used alone as a pure prosthesis. The size of harvested iliotibial band or fascia lata was just enough to wrap around the entire Dacron prosthesis. Then, the Dacron prosthesis and the harvested autograft were woven together. Reconstruction was performed through an arthrotomy incision with tourniquet control in all cases (Figure). Fixation of the graft was completed using an extraarticular staple at each end of the prosthesis. All wounds were closed in layers with a drain tube. Systemic antibiotics with cefazolin and gentamycin were administered for 1-3 days according to the status of wound healing. All patients participated in a rehabilitation program with early range of motion and muscle strengthening exercises. Ambulation training was started within a few days after surgery depending on the patient's tolerance. The patients were restricted from participating in sports until 6 months after surgery or until they achieved satisfactory range of motion and muscle strength through rehabilitation.

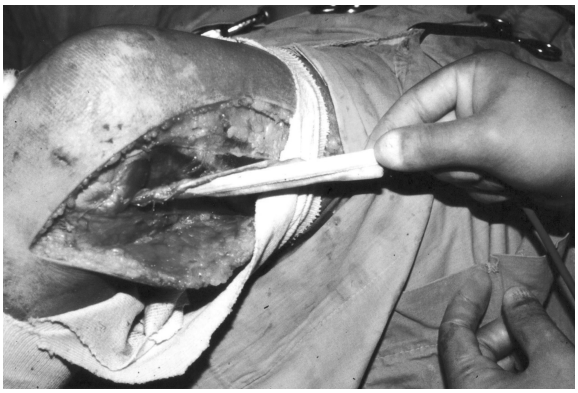

Figure. ACL was reconstructed using a Dacron prosthesis augmented with iliotibial band.

The prosthetic Dacron ligament used in this study was a composite of four tightly woven Dacron tapes wrapped in a sheath of loosely woven velour. The velour is designed to minimize abrasion of the graft and act as a scaffold for ingrowth of fibrous tissue. The graft measured 8 mm in diameter and had a mean ultimate strength of 3631 N, with a mean ultimate elongation of 18.7%. The irrecoverable plastic deformation was less than 1% after 10,000,000 cycles, and the graft had a fatigue life of 324,000,000 cycles at a reference load of 210 N. These properties are considered to be suitable for a substitute ACL [15].

The first postoperative follow-up was at 2 weeks after discharge. Patients were then followed every four weeks until three months after surgery, and then every 6 months. The result was assessed based on the subjective outcomes, including the Lysholm knee scoring scale [16], the Tegner activity scale [7] and patient's satisfactory assessment. The evaluations were completed either by interview or telephone. The Lysholm knee scoring scale consists of eight items; it is a subjective assessment of the patient's knee function and is based on a 100-point evaluation (Table 1). The combined scores are excellent (95 to 100 points), good (84 to 94 points), fair (65 to 83 points), and poor (< 65 points). The Tegner activity scale is used to evaluate functional levels pre- and postoperatively to quantify the effect of surgery on the patient's activity level. The scales range from 0 to 10, with 0 representing total incapacity resulting from the injury and 10 representing ability to participate in professional sports (Table 2). The other item used to evaluate the subjective outcomes was patient's subjective satisfaction using visual analog scale. The answer to the question "how satisfied are you with your operation?" was recorded on a discrete ordinal scale ranging from 1 to 10, where a score of 10 indicated "very satisfied" and a score of 1 indicated "very unsatisfied." We defined patient dissatisfaction as a score less than 5 on the visual analog scale.

Table 1. The Lysholm knee scale

Symptom	Points
Instability	25
Pain	25
Catching/locking	15
Swelling	10
Stair climbing	10
Lipm	5
Squatting	5
Support	5
Total	100

RESULTS

The mean follow-up period was 10.9 years (range, 2-14 yr). During these years, 12 patients (18.8%) had their Dacron prostheses removed. They were converted to autogenous bone-patellar tendon graft in 9 patients, semitendinosus and gracilis in 2 patients and allograft in 1 patient. The mean interval between initial reconstruction and revision surgery was 4.5 years (range, 2-6 yr). The remaining 52 patients were followed for a mean of 12.4 years (range, 11-14 yr).

The mean overall Lysholm knee score improved from a preoperative score of 61.3 (range, 31-80) to a final follow-up score of 81.4 (range, 51-100). At the final follow-up, fifteen patients (23%) had an excellent rating, 23 patients (36%) had a good rating, 12 patients (19%) had a fair rating, and 14 patients (22%) had a poor rating. For the 52 patients in whom Dacron ligaments were not revised, the mean preoperative Lysholm knee score was 61.7 and the final follow-up score was 85.5. Fifteen patients had an excellent rating, 23 patients had a good rating, 8 patients had a fair rating, and 6 patients had a poor rating. Of the 12 patients who had their Dacron ligaments revised, the average preoperative Lysholm knee score was 59.4 (range,

Table 2. The Tegner activity scale

Levels	Represent meaning
Levels 7 to 10	Competitive sports
Levels 4 to 6	Physical fitness activities and moderate to strenuous work activities
Levels 1 to 3	Light work and activities of daily living
Level 0	Permanent disability

31-67) and the final follow-up score was 63.7 (range, 51-67). None had excellent or good results, 4 patients had a fair rating, and 8 patients had a poor rating at the final follow-up.

The mean Tegner activity rating score improved from a preoperative average of 2.7 (range, 0-5), reflecting light work and activities of daily living, to a mean of 5.3 (range, 1-9), representing physical fitness activities and moderate to strenuous work activities, at the end of follow-up. Of the 52 patients who did not undergo revision surgery, the average score improved from a preoperative 2.8 (range, 0-5) to a final follow-up 5.9 (range, 2-9). Of the 12 patients who underwent revision surgery, the preoperative and the final follow-up scores were 2.5 (range, 0-4) and 2.9 (range, 1-4), respectively.

The average operation time was 1.6 hours (range, 1-4 h) and the average hospital stay was 4.7 days (range, 2-17 d). Complications included superficial wound infections (n = 2) and clinical synovitis (n = 3). The superficial infections healed without sequale 2 weeks after adequate debridement and appropriate antibiotics use. Of the three patients with clinical synovitis, two responded to arthroscopic debridement with complete resolution of symptoms. The third patient's symptoms did not resolve and the patient required graft removal 2 years later. At final follow-up, the mean visual analog scale for assessing satisfaction was 5.8 (range, 0-10). Thirty-five patients (55%) were satisfied with their final results.

DISCUSSION

Although some studies [7,17] have reported good short-term results of Dacron ACL reconstruction, the long-term outcomes are still questioned by several investigators [15,18]. In a prospective study to evaluate the long-term results of Dacron ACL reconstruction in 70 patients, Maletius et al [18] found that only 14% of the study group had acceptable stability and knee function. Richmond et al [15] evaluated the outcomes of ACL reconstruction with Dacron ligament prosthesis in 35 patients. They also found that the performance of these patients deteriorated subsequently through time. In the present long-term study, we found similar results. More than 40% of patients had fair to poor outcomes and the dissatisfaction rate was 45.3% at the last follow-up. We attribute these poor outcomes to the artificial nature of the Dacron ligament prosthesis, which only offers mechanical support for a certain length of time. Furthermore, the artificial ligament might induce immunologic reactions such as reactive synovitis and foreign body reaction. In the current study, however, we did not have the histological evidence to evaluate the differences in the pathologic change between Dacron ligament and fascia lata.

The results of Dacron ligaments in ACL reconstruction are less predictable than those of autologous patella tendon graft. Bach et al [19] retrospectively reviewed the results of 97 patients 5 to 9 years after arthroscopically-assisted ACL reconstruction using patella tendon autograft. The mean Lysholm score was 87. Eighty-two percent had good or excellent results according to the modified Hospital for Special Surgery knee scores. The authors claimed that ACL reconstruction using patella tendon autograft yields reliable stability and a high level of patient satisfaction. Sommer et al [20] evaluated the functional results of 178 patients after anterior cruciate ligament reconstruction using the patellar ligament bone-tendon-bone technique. Ninety-five percent of patients achieved "excellent" or "good" overall results. They concluded that reconstruction of the cruciate ligament with tissue from the patellar ligament provides good objective results as well as good subjective ratings.

Limitations of this study include all of the shortcomings inherent to a retrospective study. Also, there was no alternative treatment or control group with which to compare the results in this study. Furthermore, the follow-up examinations only focused on subjective results. Also, the rate of revision surgery was 19%, much higher than that reported for patellar tendon graft [21].

The present long-term follow-up study confirms the conclusion of other reports [11,15] that artificial ligaments are not acceptable for the

treatment of ACL-deficient knees. Although claims of acceptable results with short-term follow-ups have been published, at the present time, we are unaware of any investigation that proves that these devices have any place in the treatment of ACL injuries. Although some investigators have reported good results with new generation artificial ligaments [22,23], such as ligament advancement reinforcement system (LARS) and radio frequency-generated glow discharge (RFGGD)-treated Leeds-Keio ligament, in ACL reconstruction, the results of these studies were all based on short-term follow-up with a limited number of patients. We conclude that artificial ligaments should be reserved for salvage procedures. The use of hamstring autograft is still the standard procedure for ACL reconstruction [24,25].

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以自體組織加強後之達克隆人工韌帶進行前十字韌帶重建手術：十四年長期的主觀研究結果報告

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目的　我們對於以達克隆人工韌帶進行前十字韌帶重建手術進行一個回溯型研究來評估其主觀結果。

方法　針對64位曾經接受達克隆人工前十字韌帶重建手術的病人進行研究，平均追蹤10.9年。所有的達克隆人工韌帶都以自體組織包裹，並以「越過頂點」的手術方式重建。追蹤的重點在於主觀的結果評估：包括林氏膝部評估表、鐵格氏活動評估表、以及滿意度的評估。

結果　十二位病人在平均四點五年的時候接受達克隆人工韌帶移除手術。在最後一次的追蹤，我們發現整體的林氏膝部評估爲81.4分，鐵格氏活動評估爲5.3分。有40%的病人是「普通」到「不好」的結果，有高達45%的病人不滿意他們最後的結果。

結論　我們認爲以人工韌帶來進行前十字韌帶重建手術的長期追蹤結果仍不儘滿意。以自體韌帶來進行前十字韌帶重建手術，仍爲目前最可靠的重建方式。（**中台灣醫誌 2007;12:191-7**）

關鍵詞

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