

# Anterior Cruciate Ligament Reconstruction with or without Bracing

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## Abstract

**Background:** Rupture of anterior cruciate ligament (ACL) would cause instability and disability and if left untreated. Reconstruction is performed by different techniques including patellar bone graft, as the strongest device. Application of brace after ACL reconstructions has revealed doubtful results.

**Methods:** One hundred ACL ruptured patients randomized into two groups were reconstructed with autogenous bone-patellar tendon-bone grafts followed for 12 months. Of these, only 50 patients used braces after operation.

**Results:** There was no statistically significant difference between two groups in range of motions, complications and quadriceps atrophy after 1, 3, 6 and 12 months. Patients with no braces returned to their job and had better work performance with less patellofemoral pain at the follow up visits ( $P < 0.05$ ).

**Conclusion** The results of the present study are in favor of not using braces after ACL reconstruction with bone-patellar tendon-bone graft.

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**Keywords** • BPB graft • ACL • Brace • range of motion • quadriceps atrophy

## Introduction

**A**nterior cruciate ligament (ACL) rupture would cause knee instability and if left untreated may result disability in occupational and sport activities.<sup>1</sup> Currently, the only surgical treatment of ACL rupture is reconstruction performed by different techniques including bone-patellar tendon-bone (BPB) graft considered to be the strongest available device.<sup>2-4</sup>

After surgical operations, the inflammatory cells attack the graft and after 4-6 weeks minimizing its strength with simultaneous revascularization of graft that may last for 20 weeks.<sup>2,3</sup> Remolding phenomena, inducing normal ACL histological and biomechanical properties in BPB graft, usually occurs during a period of 12 months. Patellar tendon is one of the main donor sites for BPB graft. Post operatively, in the course of healing, there are changes, which after 12th months, the proportion of healthy to scar tissue changes with healthy tissue becoming dominant.<sup>5</sup> However, the maximum strength of BPB, graft does not exceed 70% of the normal. According to some studies post-operation failures in BPB fixation location primarily occur in femoral and tibial tunnels.<sup>3</sup> Whereas, graft strength (resistance) against tension minimizes after 4-6 weeks, BPB graft

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remodeling and bone tendon integration continue for at least several months after transplantation. Therefore, theoretically, the recommendation of classic procedure of using brace for six weeks after surgical operation cannot prevent the failure.<sup>6</sup>

After reconstruction of ACL reduced proprioception may explain the poor functional outcome in some patients, despite restoration of mechanical stability.<sup>7</sup> Furthermore, rehabilitation, with proprioceptive and agility training is an important component in restoring the functional stability in the anterior cruciate ligament-reconstructed knee.<sup>8</sup>

Recent studies have suggested that in subjects with ACL reconstruction, under isokinetic testing conditions, knee bracing can improve the static proprioception of the knee joint but not the contractile function of the muscles.<sup>9</sup> Newly performed clinical investigations have revealed that in young active people, postoperative bracing may not change the clinical outcomes after ACL reconstruction.<sup>10</sup> Moreover, some other clinical investigations, regarding the application of brace after operations for ACL reconstruction, have revealed doubtful results for brace application.<sup>11-13</sup> Considering large number of operations for ACL reconstruction performed in Isfahan, Center of Iran, especially on active sportsmen, who required simple treatments for returning to work and sport quickly, we decided to investigate the results of ACL reconstruction after operation with and without bracing.

## Patients and Methods

This study comprised a randomized clinical trial at Al-Zahra Hospital, affiliated with Isfahan University of Medical Sciences, Isfahan, Iran performed on 100 patients, 98 men and two women, underwent ACL reconstruction and used BPB procedure. The inclusion criteria were patients with ACL rupture, confirmed by clinical tests based on classical standards and required ACL reconstruction. ACL rupture was confirmed based on preoperative clinical examination namely positive Lachman and pivot tests. Active range of motion (ROM), quadriceps atrophy and patients' complaints were also recorded. They were randomly categorized into two unbraced and braced groups of equal numbers. The average age of exposed and unbraced groups were 27.1 and 26.9 years respectively. The interval between injury and surgical operation varied from one to 60 months, 9.56 months for exposed group and 8.4 months for unbraced group.

Following the operation, the brace was only used for patients in exposed group. After meticulous clinical examination, arthroscopy

was performed preoperatively to assess meniscal lesions and other intraarticular pathologies. All meniscal lesions were corrected before operation. One third of the middle patellar tendon, about 12 mm in width along with five cm of the length of patella and proximal tibia tendon, with 10 mm in width were removed through a small longitudinal incision at the anterior aspect of the knee on the patellar tendon. Notchplasty was conducted through the same incision and then tibial and femoral tunnels were placed at fully isometric locations. Finally the graft was fixed with sufficient tension using cancelus screws. Cylindrical splint at complete extension of knee was used following the operation.

The rehabilitation periods were similar in all patients of the two groups. The splint was removed and the wound was examined three to four days after operation. In the intervention group, the patients used hinged flexion, with controllable braces. Both groups received instructions on isometric strengthening of quadriceps, passive patellar movements, and passive assisted knee movements and were walking in partial weight-bearing state using crutches. Active assisted extension of knee was allowed four weeks after operation.

Six weeks after operation, crutches were discarded along with removal of the braces in the exposed group, when patients of this group enjoyed a minimum of 90 degrees flexion. All patients were encouraged to swim and run. After six months, in case of sufficient strength and stability of muscles, and conforming to standard principles, the patients were permitted to participate in conventional exercises.

## Statistical Analyses

Data were presented as mean±SD. When appropriate, two-sample independent t-test, Chi-square test and for ACL rupture Wilcoxon test were used, and  $P < 0.05$  was considered as statistically significant.

## Results

The mean range of motion (ROM) after one month and three months were 128 and 140 cm in unbraced and 126 and 139 cm in exposed groups respectively. After treatment all patients in the exposed, and 98% of unbraced groups returned to work. The average period of returning to work after operation was 1.84 months for unbraced and 2.28 months for exposed groups. None of the aforementioned data of each group were statistically difference from each other. Complete exercise was recommended for 36% of patients the exposed and 52% of unbraced groups.

The only observed complication in both groups was lateral knee numbness, which occurred in 6% and 8% of patients in unbraced and exposed groups respectively. None of the patients of the two groups needed re-surgery. Climbing up stairs without difficulty was observed in 96% and 93% of exposed and unbraced patients respectively. The complaints of the patients of both groups decreased significantly after operation.

The study comprised especial tests for ACL rupture performed before and after operation. Wilcoxon test demonstrated that in both groups, the entire tests for different rates showed meaningful decrease in view intensity. No significant difference was found in frequency distribution of pain in patellofemoral region, while squatting, cutting and running in both groups. The frequency distribution of quadriceps atrophy between the two groups before and after operation was not statistically significant and no correlation was found between exercise recommencing and the rates of quadriceps atrophy nevertheless. However, there was a significant correlation between the resumption of exercise and decrease of patellofemoral pain rate.

## Discussion

During the past two decades, the rehabilitation protocols have become increasingly aggressive.<sup>14-18</sup> In spite of this fact, rehabilitative knee braces is currently recommended after ACL reconstruction surgery. The main role of these braces is to limit ROM and guard against varus and valgus strains in the early postoperative period.<sup>19</sup> Previous studies have found that most types of rehabilitative braces are effectively capable of guarding the graft against undesired forces.<sup>20</sup> In comparison with cast immobilization, their benefits over more aggressive rehabilitation programs are not well understood.

There are some disadvantages in using postoperative braces. The incorrect placement of a brace enhances the forces on the reconstructed ACL and can also compromise the venous circulation of the leg which may cause premature muscle fatigue in the braced leg.<sup>21,22</sup> On the other hand, continuous improvement in ACL reconstruction surgery due to more advanced operation techniques, stronger graft materials and interference screw fixation have resulted in more excellent primary stability.<sup>17</sup> Thus, it seems reasonable to conclude that more aggressive rehabilitation programs can now be recommended.<sup>14,15</sup>

Based on prospective studies, early motion in a braceless rehabilitation program is encouraged, and has shown to have no adverse effects

regarding immediate postoperative recovery or outcome after one year.<sup>13,23</sup> Two-year follow-up based on KT-1000 instrumented Lachman test also demonstrated that the use of a postoperative rehabilitation brace may not influence the objective stability of the knee.<sup>11,12,15</sup> In our series, the objective parameters such as ROM, quadriceps atrophy and manual tests for ACL stability, as well as patellofemoral pain, sport and job recommencing were comparable in patients rehabilitated with or without brace. Lower costs and probably higher level of patients' satisfaction, although not objectively measured, in a braceless rehabilitation program makes this strategy more favorable. Taken together, we believe that rehabilitation program without bracing is safe and can be recommended instead of routine strategies.

In our patients, one month after operation, the average ROM in both groups was greater than is presented in the textbooks.<sup>1</sup> This is probably due to the more freedom in patients' knee movement. Nevertheless, ROM was similar to the classical schedule developed after three months. Despite the slight limitation of ROM in only two cases in each category, all patients enjoyed full ROM after six months with no statistically significant differences between them during the preceding periods.

Returning to work was approximately complete in two groups. In the unbraced group, due to the absence of limitation caused by the brace, this happened more rapidly and differed significantly from braced group. The patients of the unbraced group returned to their usual daily activity earlier but with respect to sport activities, there were no differences among them. Further subjective analysis showed that, except in patients with pain and other distressing symptoms, the main cause of abandoning sports in our patient were due to the fear of re-rupturing ACL. In regard to the quality of climbing stairs patients of both groups performed well and there was no significant difference with respect to their performances.

The only apparent complication was lateral numbness of the knee, noticeable after surgical operation, which decreased gradually. However, after one year the recovery was remarkable due to gradual innervations of the location. In 79% of our patients, pain was the most common complaint before operation which significantly decreased post-operationally in both groups. However, a slight pain that created no limitation of movement remained in 8% of exposed and 7% of unbraced cases. Giving way before operation was found in 67% of complaining patients, which decreased to 9% after operation and was indicative of successful operations.

As for patellofemoral pain, no statistically meaningful difference was found between two groups before and after operation. Studies showed that this pain was significantly less in patients who recommenced the sport, compared to those who abandoned exercise, an observation supporting the effect of exercise on muscle strengthening and creation of balance in knee supportive muscles.

There was no difference between two groups in respect of pain while squatting, cutting and running. In both groups reduction in atrophy of quadriceps occurred post-operationally, compared with that of pre-operation. This was due to the therapeutic effect of ACL reconstruction and effectiveness of brace. ACL rupture was prevalent in among young and middle aged patients.<sup>1-4</sup> Women suffer ACL rupture less frequently because they seldom participate in competitive group games. No difference was shown between two groups concerning the distribution frequency of injuries, quality of occurrence, mechanism of injury, and the interval between injury and operation.

The results of this investigation were in agreement with those of other studies,<sup>5-8</sup> showing that, in respect of knee stability and function of the patient, utilizing or not utilizing the brace did not affect the therapeutic outcomes.

## Conclusion

The results of the present study are in favor of not using braces after anterior cruciate ligament reconstruction with bone-patellar tendon-bone graft, and no significant difference was found between two groups.

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