

# Effect of Smoking on Arthroscopic ACL Reconstruction-A Prospective Study

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## ABSTRACT

**Introduction:** Smoking and other tobacco use is the leading preventable cause of premature morbidity and mortality in India. It has been reported that many orthopaedic conditions have been complicated and adversely affected by tobacco. The study is about the effect of smoking on ACL reconstruction

**Material and Methods:** This was a prospective study in which 114 patients, with age group between 18-60 years who underwent ACL reconstruction were included. Two groups were created group1 were smokers and group 2 included non smokers.

**Results:** Subjective IKDC score in group1 {56.2 (21.4-83.6)} was lower than group 2 {72.3 (25.3-96.4)} and lachman test shows more laxity in group1 indicating the adverse effect of smoking on results of ACL reconstruction.

**Conclusions:** Smoking has an adverse effect on the functional result after arthroscopic ACL reconstruction

**Keywords:** Smoking, ACL Reconstruction, IKDC Scoring

## INTRODUCTION

It is estimated that about 94.3 million men and 7.6 million women in India, or 29.3% of men and 2.4% of women are smokers.<sup>1</sup> In India there are many forms of smoking like cigarettes, beedi and hukka. Smoking and other tobacco use is the leading preventable cause of premature morbidity and mortality in India, and it is estimated that one million people in India die each year because of tobacco consumption.<sup>2</sup> The adverse effects of smoking on conditions such as cancer<sup>3</sup>, diabetes<sup>4</sup>, and cardiovascular disease<sup>5</sup> have been well documented. Tobacco has been reported to play a vital role in many orthopaedic conditions like bone mineral density fracture healing, spinal fusion, wound repair, lumbar disc disease, and rate of hip fracture.<sup>6</sup> Nicotine could also adversely affect ACL reconstruction and other knee surgeries. Although orthopaedic surgeons have known about these potential complications of smoking on knee surgery, there have only few known comprehensive reviews on the topic.

Due to marked improvement in ACL reconstruction techniques, it has become the treatment of choice for patients with functional instability of knee. Although majority of patients show good to excellent results, in terms of stability and pain relief, 0.7 - 10% of patients suffer recurrent instability due to graft failure. Because of the graft failure, significant number of patients will eventually undergo revision surgery. After ACL reconstruction, the graft undergoes a complex biological process called ligamentisation. Initially the tendon that has been grafted undergoes inflammation and necrosis followed by revascularisation and repopulation

with fibroblasts. Later on, modification of the collagenous structure and remodelling of the graft. Failure of any of these processes may lead to hypocellularity, extensive necrosis, poor vascularisation of the graft, which in turn can lead to failure of the graft to incorporate. Nicotine, a major component in cigarette smoke causes inhibition of fibroblasts, red blood cells, and macrophages. Nicotine is also a potent vasoconstrictor<sup>7</sup> and impairs the revascularisation of healing bone.<sup>8</sup> Tobacco combustion in cigarettes releases tissue-damaging oxygen free radicals, in addition to tar, ammonia, formaldehyde, lead, and many other unidentified organic particulates. Inhaled carbon monoxide reduces tissue oxygenation and impairs the microcirculation within healing soft tissue and bone.

The purpose of this study was to understand the potential role of tobacco smoking on ACL reconstruction. This paper compares the clinical outcome of this procedure between a cohort of smokers and a matched group of non-smokers.

## MATERIAL AND METHODS

This was a prospective study in which 114 patients, with age group between 18-60 years who underwent ACL reconstruction were included. Ethical clearance for the study was taken from the ethical committee of our medical university. Informed consent was taken from all the patients before surgery. All the surgeries were carried out between 2011 and 2015 using similar technique (femoral fixation by endobutton and tibial side by biodegradable screw).

We identified 61 patients who resorted to smoking preoperatively as well as during rehabilitation and placed them in group 1. A second group (group 2) of non-smokers was created in which 53 patients were kept who underwent reconstruction of ACL using the same criteria. Patients with age <18 years and patients with multiligament injury, patients with revision surgery were excluded from the study. The same independent reviewer evaluated the results of all patients in both groups. Annual subjective and objective evaluation was performed from one year after operation using the International Knee Documentation Committee (IKDC) evaluation proforma, with scores from the most recent evaluation being used in the analyses.

Measurements of laxity were carried out using lachman test.

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The severity of laxity was graded as grade I (<5mm), grade II (5-10mm) and grade III (>10mm).

**Follow Up:** The patients were regularly followed up with follow up period ranging from 1 year -5 years and their evaluation was done using IKDC scoring and lachman test. On each follow up patient were provided with a IKDC proforma and the patients were said to fill the forms by themselves and then IKDC score was calculated. Similarly on each follow up lachman test was done to assess the laxity objectively. The data collected over the years was statistically analyzed to get the results of the study.

## RESULTS

After statistical analysis, results of the study were generated. The mean age at the time of surgery was 29 (18-48) years in group 1 and 31 (18-58) in group 2. The mean follow up was of 19 (12-30) months in group 1 and 21 (12-42) months in group 2. Medial meniscus tear was present in 38.7 % of the cases and 31.8% of patients of group 2. Lateral meniscus tear was present in 28.1 % of cases in group 1 and 39.6% of the cases in group 2 (Table-1). The subjective IKDC score was much higher in the non-smoker group 72.3 (25.3-96.4) as compared to 56.2 (21.4-83.6) in smoker group and the difference was significant ( $p < 0.005$ ). The Level of highest activity score was 2.9 (1-5) in

group 1 as compared to 3.2 (1-5) in group 2. The frequency of pain score was 6.2 (1-10) in group 1 and 7.3 (1-10) in group 2. The Severity of pain score was 6.2 (1-10) in group 1 and 8.1 (1-10) in group 2. The Level of activity limited by swelling score was 3.0 (1-5) in group 1 and 3.8 (1-5) in group 2. The Knee locking or catching score was 0.3 (0-1) in-group 1 and 0.4 (0-1) in-group 2. The Highest level of activity before giving way score (subjective instability score) 3.1 (1-5) in group 1 and 3.4 (1-5) in group 2. The Highest level of pre-injury sport score was 3.8 (1-5) in group 1 and 3.5 (1-5) in group 2. The Highest level of post-rehabilitation sport score was 2.9 (1-5) in group 1 and 3.6 (1-5) in group 2. The Overall knee function Following reconstruction of the anterior cruciate ligament score was 7.1 (1-10) in non-smokers group as compared to 5.9 (1-10) in group 2. So non smokers had a better knee function as compared to the smokers (Table-2).

All grades of Lachman test laxity was more in the smokers group clearly indicating the adverse effect of smoking on ACL reconstruction (Table-3).

## DISCUSSION

The study clearly indicates that smoking affects functional outcome of ACL reconstruction and the people who smoke have a poor functional outcome as compared to nonsmokers. Both the subjective evaluation (by IKDC scoring) and objective evaluation (lachman test) have supplemented the hypothesis. Beside other medical problems smoking is said to play a vital role in many orthopaedic conditions, such as fracture healing, wound repair, bone mineral density, disc disease, and various hip fractures. Till now, there are not very much studies that how smoking affects the outcome of the various knee pathologies specially ACL reconstruction. There are several methods that has been used to know the final outcome and rehabilitation in knee surgery. In our study we have used IKDC scoring and Lachman test. IKDC evaluation is the most widely used scoring system but, there is some criticism for the IKDC scoring too

Category	Group I	Group II
Mean age at time of surgery (range)	29 (18-48)	31 (18-58)
Mean follow-up (mths; range)	19 (12-30)	21 (12-42)
State of medial meniscus		
Normal (%)	61.3	68.2
Stable tear present (%)	21.7	20.1
Unstable tear present (%)	17	11.7
State of lateral meniscus		
Normal (%)	71.3	70.4
Stable tear present (%)	19.6	15.6
Unstable tear present (%)	9.1	14

**Table-1:** Pre-operative comparison between the two groups

Category	Group I (Smokers)	Group II (Non- smokers)
Subjective IKDC score	56.2 (21.4-83.6)	72.3 (25.3-96.4)
Level of highest activity score	2.9 (1-5)	3.2 (1-5)
Frequency of pain score	6.2 (1-10)	7.3 (1-10)
Severity of pain score	6.2 (1-10)	8.1 (1-10)
Level of activity limited by swelling score	3.0 (1-5)	3.8 (1-5)
Knee locking or catching score	0.3 (0-1)	0.4 (0-1)
Highest level of activity before giving way score (subjective instability score)	3.1 (1-5)	3.4 (1-5)
Highest level of pre-injury sport score	3.8 (1-5)	3.5 (1-5)
Highest level of post-rehabilitation sport score	2.9 (1-5)	3.6 (1-5)
Patients own functional assessments		
Go upstairs	4.0 (1-5)	4.3 (1-5)
Go downstairs	4.2 (1-5)	4.6 (1-5)
Kneel on knee	3.0 (1-5)	3.6 (1-5)
Squat	3.1 (1-5)	3.8 (1-5)
Sit with knee bent	3.8 (1-5)	4.2 (1-5)
Rise from chair	4.2 (1-5)	4.5 (1-5)
Run straight ahead	3.5 (1-5)	4.0 (1-5)
Jump and land on affected leg	2.6 (1-5)	3.2 (1-5)
Stop and start quickly	3.2 (1-5)	3.7 (1-5)
Overall knee function		
Prior to injury score	9.4 (1-10)	9.5 (1-10)
Following reconstruction of the anterior cruciate ligament score	5.9 (1-10)	7.1 (1-10)

**Table-2:** Post-operative results of subjective International Knee Documentation Committee (IKDC) analyses (mean; range)

Category	Group I	Group II
Grade I	46.1	71.2
Grade II	32.3	17.1
Grade III	21.6	11.7

**Table-3:** Post-operative comparison of lachman test between the two groups

because scoring is based completely on patients' subjective perceptions of their physical recovery and rehabilitation. However, the IKDC evaluation was used as it's a widely available, recognised and validated test of subjective and objective findings after knee surgery.<sup>9</sup> Smoke of the cigarette consist of nearly 500 different gases, including nitrogen, carbon monoxide and hydrogen cyanide, and thousand of the chemicals nicotine is one of the important of them.<sup>10</sup> The chemical that causes various adverse effect in musculoskeletal problems is not exactly clear but Nicotine has been shown to promote platelet aggregation, reduce microvascular prostacyclin levels, inhibit the function of fibroblasts, red blood cells, and macrophages leading to vasoconstriction, reduced blood supply<sup>11</sup> leading to the various adverse effect in the knee surgery.

In our study, the exact quantification of the pack-years of smoking (number of packets of cigarettes, smoked per year) and the duration since starting of smoking habit by group 1 prior to surgery and during rehabilitation was not taken into consideration. One of the major reason behind it was significant discrepancy between actual and admitted. Similar previous studies of smoking habits have demonstrated significant discrepancies between actual and admitted use.<sup>12</sup>

Also, in our indian scenario where there is unfavourable stigma of smoking associated with healthcare and surgery may have resulted some patients not disclosing their true level of smoking. So, this factor can lead to some favour towards group 1. Till now there are few studies deicated to effect of smoking on ACL reconstruction but there are studies which shows the adverse effect of smoking on various components of knee joint like cartilage, menisci and other ligaments.

## CONCLUSION

Smoking has adverse effect on all type of surgeries on knee including ACL reconstruction. so, patients should be counselled for negative effect of smoking on ACL reconstruction and cessation of smoking before and after Acl surgery should be promoted.

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