The Effects of Nicotine Use On Clinical Outcomes of Multiligament Knee Injuries

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Background

Smoking has a well-established relationship with cardiopulmonary disease\textsuperscript{1,2}, and is a major preventable cause of morbidity and mortality\textsuperscript{3}. Limited wound healing, postoperative infection, and insufficient bone graft healing are all documented complications associated with nicotine use\textsuperscript{4,5,6,7,8}. Recent ACL reconstruction literature has demonstrated deteriorated subjective and objective clinical outcomes in smokers, as well as poorer outcomes with allograft use\textsuperscript{9,10,11}. Smoking also displays a dose-dependent relationship with increasing postoperative knee laxity\textsuperscript{9}.

Relative to isolated ACL injuries, multiligament knee injuries (MLKI) represent a greater level of complexity, and greater opportunity for smoking to negatively affect outcomes. These injuries are often associated with a higher degree of soft tissue damage, vascular compromise, open procedures, and allograft use. Many of these injury patterns are best managed acutely, which does not allow much time for preoperative smoking cessation. This study compares clinical outcome scores of multiligament knee reconstructions between smokers and nonsmokers, and assesses any differences in complications, revision rate, or other objective outcomes such as stability rating and range of motion.
Methods

A retrospective chart review was performed for 160 consecutive radiographic knee dislocation patients from 2005-2015 with two or more ligaments with Grade 3 instability requiring repair or reconstruction. Eligible ligaments included the ACL, PCL, MCL, LCL, or popliteus. All patients were operated on at a level 1 trauma center by a single surgeon. Additional inclusion criteria consisted of documented nicotine use and greater than 2 years of follow up with clinical outcome scores. Preoperative data collection included patient demographics, injury pattern, associated injury (nerve, vascular, etc.), and injury timing to procedure. Smoking status was assessed, and patients who identified positively for any smoking history were further stratified based on all available data, including number of pack-years, length of quit time before surgery if applicable, and whether or not the patient smoked after surgery.

Operative data collection included the type of operation performed, and whether it was open, arthroscopic, or both, repair vs. reconstruction, and graft type. Posteroperative data collection focused on Clinical Outcome Scores (Lysholm, IKDC, & SMFA) at each follow-up appointment. Additional postoperative data included knee range of motion and stability grading, as well as postoperative complications including infection (superficial or deep), deep venous thrombosis and/or pulmonary embolism, arthrofibrosis, reoperation rate, instability, graft failure, amputation, and death.
A total of 118 patients were included; 73 nonsmokers and 45 smokers (minimum one daily pack cigarettes/chew). Of the 45 patients in the smoking category, 12 had discontinued smoking at time of surgery, while 33 continued to smoke. Mean time to treatment was $22 \pm 19$ days.

**Figure 1**: Proportion of nicotine users relative to overall patient population
Results

Figure 2: Smokers have worse post-operative outcome scores after MLKI repair. Mean Lysholm knee score for smokers was $61.1 \pm 3.7$, with $67.2 \pm 3.5$ for nonsmokers (score ranges from 0-100). Mean International Knee Documentation score (IKCD, range 0-100) for smokers was $47.6 \pm 3.7$, compared to $55.3 \pm 2.5$ for nonsmokers.

Figure 3: Smokers have more operative complications than nonsmokers during MLKI repair. Relative to nonsmokers, smokers also had higher incidences of postoperative superficial infection (6.67% of smokers, 1.37% of smokers) and pulmonary embolism (4.44% of smokers, 0.0% of nonsmokers).
### Degree of Knee Motion in MKLI for Smokers vs. Non-Smokers

<table>
<thead>
<tr>
<th></th>
<th>Pre-Operation</th>
<th></th>
<th>Post-Operation</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Smoking</td>
<td>Non-smoking</td>
<td>Smoking</td>
<td>Non-Smoking</td>
</tr>
<tr>
<td>Normal</td>
<td>22 (50.0%)</td>
<td>50 (67.6%)</td>
<td>22 (50.5%)</td>
<td>45 (60.8%)</td>
</tr>
<tr>
<td>Hyperextension</td>
<td>21 (47.7%)</td>
<td>23 (31.1%)</td>
<td>20 (45.5%)</td>
<td>29 (39.2%)</td>
</tr>
<tr>
<td>Forced Contracture</td>
<td>1 (2.3%)</td>
<td>1 (1.4%)</td>
<td>2 (4.5%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>74</td>
<td>44</td>
<td>74</td>
</tr>
</tbody>
</table>

**Figure 4:** Smokers have comparatively less range of motion than nonsmokers at postoperative follow-up for MLKI. At last follow-up (mean 22 months), 50% of smokers had a range of knee motion classified as normal (0-135° ± 10°), whereas 60.8% of nonsmokers had a normal range of motion (hyperextension defined as range of motion greater than 135°). Additionally, the smoking population was the only group to display postoperative forced contracture (defined as range of motion less than 90°).
Conclusions

Relative to non-smokers, nicotine use is associated with worse clinical outcomes, increased incidence of atypical postoperative range of motion, and more complications (pulmonary embolism, superficial infection) with MLKI. This could lead to a prognosis change for smokers, further emphasizing their need to quit, and potentially lead to timing modifications for certain injury treatments and graft choices. To our knowledge this is the first study of its kind, pivotal to further understanding factors that lead to poor outcomes in multiligament knee reconstructions and how to prevent them.
References