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CANNABIS USE INCREASES RISK FOR REVISION AFTER TOTAL KNEE ARTHROPLASTY

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Abstract

As an increasing number of states begin to legalize marijuana for either medical or recreational use, it is important to determine its effects on joint arthroplasty. The purpose of this study is to determine the impact of cannabis use on total knee arthroplasty (TKA) revision incidence, revision causes, and time to revision by analyzing the Medicare database between 2005 and 2014. A retrospective review of the Medicare database for TKA, revision TKA, and causes was performed utilizing Current Procedural Terminology (CPT) and International Classification of Disease ninth revision codes (ICD-9). Patients who underwent TKA were cross-referenced for a history of cannabis use by querying ICD-9 codes 304.30–32 and 305.20–22. The resulting group was then longitudinally tracked postoperatively for revision TKA. Cause for revision, time to revision, and gender were also investigated. Our analysis returned 2,718,023 TKAs and 247,112 (9.1%) revisions between 2005 and 2014. Cannabis use was prevalent in 18,875 (0.7%) of TKA patients with 2,419 (12.8%) revisions within the cannabis cohort. Revision incidence was significantly greater in patients who use cannabis ($p < 0.001$). Time to revision was also significantly decreased in patients who used cannabis, with increased 30- and 90-day revision incidence compared to the noncannabis group ($P < 0.001$). Infection was the most common cause of revision in both groups (33.5% nonusers versus 36.6% cannabis users). Cannabis use may result in decreasing implant survivorship and increasing the risk for revision within the 90-day global period compared to noncannabis users following primary TKA.

Keywords

cannabis; total knee arthroplasty; replacement; revision; survivorship

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I. INTRODUCTION

Substance misuse and dependence are a growing problem in the United States with approximately 8.1% of the population over the age of 12 being classified with substance use disorder in the past year.¹ Cannabis dependence has increased over time, reflected by a 22% increase in global burden since 1990, making it one of the most commonly used substances.² Smoking cannabis produces a wide array of psychotropic effects, as the plant contains multiple cannabinoids, of which delta-9-tetra hydrocannabinol (THC) is the most recognized, in addition to an estimated 340 additional chemical compounds.³ Regular use has been associated with decreased pulmonary function and increased risk of anxiety, depression, and psychotic illness.⁴⁻⁷

People utilize cannabis for the perception of euphoria, alterations in mood, and changes in the perception of time and place.⁸ Alternatively, negative side effects can also occur, such as dysphoria, anxiety, sedation, dizziness, and cross tolerance to other substances.^{9,10} Therefore, in the perioperative setting, all aspects of cannabis use must be taken into account. Anecdotal reports detail high anesthetic requirements, and a recent study demonstrated an increase in Propofol doses required to achieve successful laryngeal mask insertion and intubation in cannabis users.¹¹ Although rare, case reports have described reports of coronary ischemia, myocardial infarction, pulmonary edema, and cerebral ischemia even in young adult cannabis users.^{7,12}

There is a paucity of literature describing the effects of cannabis use in patients undergoing joint arthroplasty. Multiple studies have described increased complication rates with drug misuse following hip and knee arthroplasty; however, such complications are characteristic of intravenous drug injection as opposed to inhalation or ingestion.¹³⁻¹⁶ One study analyzing drug misuse in general describes increased surgery-related complications and longer hospital stays in substance abusing patients who undergo total hip and knee replacements. However, this study did not limit its analysis to cannabis use alone.¹⁶ The purpose of the present study is to determine the effects of cannabis on total knee arthroplasty (TKA) revision incidence, revision causes, and time to revision by analyzing the Medicare database between 2005 and 2014.

II. Methods

A retrospective review of the Medicare database within the PearlDiver Supercomputer (Warsaw, IN) for TKA, cannabis use, revisions, and causes was performed. The PearlDiver database is a publicly available Health Insurance Portability and Accountability Act (HIPAA)-compliant national database compiled from a collection of Medicare records from 2005 to 2014. The database contains Current Procedural Terminology (CPT) and International Classification of Disease ninth revision codes (ICD-9).

Patients who underwent TKA were identified with CPT-27447 and ICD-9 81.54. These patients were then cross-referenced for a history of cannabis use by querying ICD-9 codes 304.30-32, and 305.20 – 22. The resulting patients were then longitudinally tracked postoperatively for TKA revision (TKAR) by CPT codes 27486 and 27487, and ICD-9

codes 00.80–00.84 and 81.55. Causes for revision were identified with ICD-9 codes 996.40–47, 996.49, 996.66–67, 996.77–78, 718.46, 718.56, and 718.86. These codes correspond with mechanical loosening, failure/break, periprosthetic fracture, osteolysis, infection, pain, arthrofibrosis, instability, and trauma, respectively. Time to revision and gender were also investigated.

Statistical analysis of this study was primarily descriptive. A Kaplan Meier Survival analysis was performed to determine significance of survival and time to revision. Statistical analysis was performed with SPSS Version 21 (IBM, Armonk, NY).

III. RESULTS

Our analysis returned 2,718,023 nonuser TKAs and 247,112 (9.1 %) revisions between 2005 and 2014. Cannabis use was prevalent in 18,875 TKA patients with 2,419 (12.8%) revisions within the cannabis cohort. A description of annual trends in the TKA revision rate between cannabis users compared to nonusers is found in Table 1, which demonstrates a significantly higher revision incidence ratio in cannabis users ($p < 0.001$).

TKA utilization was greatest in patients aged 65–69 in nonusers (688,579; 27.4%) and < 65 in cannabis users (6,924; 73.5%) (Table 2). Chi square analysis demonstrated significantly higher revision rates in both cohorts in patients < 65 ($p < 0.001$) (Odds Ratio 0.72, 95% CI 0.67–0.77). Female patients were also more likely to receive TKA in both study groups compared to their male counterparts.

Time to revision was found to be significantly decreased in patients who used cannabis, with mean time to revision in the cannabis group being 739.2 days compared to 828.2 days in nonusers (89 days sooner in cannabis users) ($P < 0.001$). Notably, mean time to revision was significantly increased in the cannabis group for both 30-day (3.7% nonusers versus 5.8% in cannabis users) and 90-day (8.5% nonusers versus 11.5% in cannabis users) postoperatively (Table 3). Survivorship was measured utilizing the Kaplan-Meier survival curves as depicted in Fig. 1.

Infection was found to be the most common cause of revision in both groups, with the overall infection incidence being higher in the cannabis group (33.5% nonusers versus 36.6% in cannabis users). Mechanical loosening, implant failure, peri-prosthetic fracture, and osteolysis were found to be somewhat lower in the cannabis group (17.4, 4.6, 2.2, and 1.1%) versus nonusers (20, 6.1, 2.9, and 1.6%), respectively (Table 4).

IV. DISCUSSION

Few studies have examined the influence of cannabis use on total joint replacement to date. This study is the first to evaluate the influence of cannabis use in the setting of TKA. The primary results of this study suggest that cannabis use may be a risk factor for postoperative infection, requiring revision surgery following primary TKA. Our study also shows that the TKAR incidence increased mostly during the 30- and 90-day postoperative period, which, especially in the era of the comprehensive care for joint replacement model and bundled-payment initiatives, could have a substantial effect on the overall cost of the index procedure

considering that the increased revision rate lies within the 90-day global postoperative period.

The TKA revision rate in cannabis users was significantly increased (12.8%) compared to nonusers (9.1%), with infection being the most common cause overall (33.5% nonusers versus 36.6% cannabis users). A prior study utilizing the National Hospital Discharge Survey (NHDS) investigating drug misusers (opioid, cocaine, cannabis, amphetamines, inhalants, and sedatives) who underwent TKA or total hip arthroplasty (THA) found that drug misusers had higher rates of surgery-related complications ($P < 0.001$).¹⁶ Although this study did not specifically investigate TKAR, the authors similarly found a higher rate of periprosthetic joint infections (1.6% compared to 0.1 %; $P < 0.001$) in the drug misusers group.¹⁶ The increased risk of infection may be due to tetrahydrocannabinol's (THC) immunosuppressive effect, which, as has been hypothesized in the literature, impairs the release of pro-inflammatory cytokines and therefore weakens the immune response.¹⁷ Interestingly, however, this very immunosuppressive effect is also thought to be the basis for treating arthritis-induced pain by modulating the inflammatory response in the arthritic joint.¹⁸

Our analysis additionally demonstrates a lower rate of periprosthetic fracture, mechanical loosening, implant failure, and osteolysis as a cause of TKAR in the cannabis-user group. Although these findings did not reach statistical significance, they may in part be explained by studies that investigated the effect of up-regulating cannabinoid receptors (CB) of the skeleton in mice. Bab et al.¹⁹ illustrated that THC activates CB-2, a cannabinoid receptor expressed on osteo-blasts and osteoclasts. Activating the CB-2 receptor was found to stimulate bone formation, balance bone remodeling, and perhaps play a protective role against age-related bone loss.^{19,20} However, a clinical cross-sectional study of a group of 109 heavy cannabis users (comprised of mostly young men) showed that the heavy cannabis user group had substantially lower bone mineral density (BMD) Z-score values at the lumbar spine and hip evident on DEXA scans, and therefore concluded that heavy cannabis use may lead to an increased risk of fracture compared to non-heavy cannabis users.²¹ Furthermore, a retrospective study that utilized the National Health and Nutrition Examination Survey from 2007 to 2010 investigated 4,743 participants between the age of 20 and 59 with self-reported history of cannabis use. This study, on the contrary, did not find a correlation between cannabis use and low BMD through DEXA scans of the proximal femur and lumbar spine.²² In general, there is a considerable lack of evidence-based research discussing the effect of cannabis on musculoskeletal and bone health. This study aims to emphasize on the need for future research on this topic and highlights findings related to cannabis use and primary TKA.

A. Limitations

This study is not without limitations. The PearlDiver database is reliant upon accurate CPT or ICD coding, which creates the potential for a reporting bias. In addition, cannabis codes were derived from ICD9 codes that code for dependence or abuse. Finally, patient comorbidities were not stratified within the scope of this study.

B. Strengths

One of the strengths of this study is the large patient population that was analyzed. In addition, our study adds significant value to the body of knowledge because it describes the effects of cannabis use on total joint arthroplasty patients, which has yet to be adequately investigated in the orthopaedic surgery literature.

V. CONCLUSION

In the era of the bundled payment initiative, in addition to improving patient outcome, it is important to recognize additional risk factors that could lead to a higher complication rate and therefore cost. Cannabis use may play a role in decreasing implant survivorship following primary TKA as well as increasing the risk for revision compared to noncannabis users. Infection is the most common cause for revision in this study group. With the increased abundance of cannabis users in the United States following legalization of both medical and recreational use in some states, it is important to conduct further research to investigate the effects of cannabis on total joint arthroplasty.

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A significant difference was found to be present when comparing groups ($p < 0.001$)

FIG. 1:
Kaplan-Meier Survival Analysis curve comparing implant survival until revision between cannabis users and nonusers. Survival rates are shown at 30 and 90 days postoperatively.

TABLE 1:

TKA and TKAR Annual Trend

Year	Non-User TKA	TKAR		Cannabis TKA	TKAR	
2005	264345	22165	8.4%	912	123	13.5%
2006	263017	22097	8.4%	1136	166	14.6%
2007	267894	22965	8.6%	1372	242	17.6%
2008	268766	23338	8.7%	1487	254	17.1%
2009	267300	23778	8.9%	1671	281	16.8%
2010	280058	24857	8.9%	1949	320	16.4%
2011	269833	26635	9.9%	2332	322	13.8%
2012	278008	27189	9.8%	2580	278	10.8%
2013	281376	27189	9.7%	2601	247	9.5%
2014	277426	26899	9.7%	2835	186	6.6%
Total	2718023	247112	9.1%	18875	2419	12.8%

TABLE 2:

TKA and TKAR by Gender

Gender	Non-User TKA	TKAR		Cannabis TKA	TKAR	
Female	1508017	131294	8.7%	4306	478	11.1%
Male	843197	83661	9.9%	4041	431	10.7%
Unknown	33809	2550	7.5%	175	22	12.6%

TABLE 3:

Time to Revision

Time	TKAR	Cannabis
Average (Days)	828.2	739.2
Median (Days)	581	513
30 Days	3.7%	5.8%
90 Days	8.5%	11.5%
6 Months	16.0%	20%
1 Year	34.0%	38%

TABLE 4:

Cause for Revision

Cause	TKAR	Cannabis
Mechanical Loosening	23413	258
Failure/Break	7080	68
Periprosthetic Fracture	3434	32
Osteolysis	1849	17
Infection	39172	543
Pain -Joint Replacement	29499	361
Arthrofibrosis	7168	81
Instability	3972	69
Trauma	1220	53