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Patient perceptions of the use of medical marijuana in the treatment of pain following musculoskeletal trauma. A survey of patients at two trauma centers in Massachusetts.

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Abstract

Objective: The purpose of this study is to evaluate musculoskeletal trauma patients' beliefs regarding the usefulness of marijuana as a valid medical treatment for post-injury and post-operative pain and anxiety.

Design: Prospective survey

Setting: Two academic level 1 trauma centers

Patients/Participants: 500 patients in an orthopedic outpatient clinic

Intervention: Survey

Main Outcome Measurements:

1. Do patients believe that marijuana can be used as medicine?
2. Do patients believe that marijuana can help treat post-injury pain?
3. Are patients comfortable speaking with their healthcare providers about medical marijuana?

Results: The majority of patients felt that marijuana could be used to treat pain (78%, 390) and anxiety (62%, 309). Most patients (60%, 302) had used marijuana at least once previously, while only 14% reported using marijuana following their injury. Of those that used marijuana during their recovery, 90% (63/70) believed that it reduced symptoms of pain; and 81% (57/70) believed that it reduced the amount of opioid pain medication they used.

Conclusions: The majority of patients in this study believed that medical marijuana is a valid treatment and that it does have a role in reducing post-injury and post-operative pain. Those patients who used marijuana during their recovery felt that it alleviated symptoms of pain and reduced their opioid intake. Our results help inform clinicians regarding the perceptions of trauma patients regarding the usefulness of marijuana in treating pain, and support further study into the utility of medical marijuana in this population.

Level of Evidence: Prognostic Level II

Keywords: Marijuana; medical marijuana; post-operative pain; musculoskeletal trauma

Introduction

There has been significant debate in the United States about the utility of medical marijuana. Despite federal laws limiting the sale and distribution of marijuana, 25 states and the District of Columbia currently allow the prescription of marijuana for the treatment of medical conditions.[1] Based on the 2013 National Survey on Drug Use and Health (NSDUH), the prevalence of current marijuana use in all adults aged 18 years and over was 7.6%.[2] Marijuana is the most common illicit substance used in the US. It has been demonstrated that there is a higher odds of marijuana use in states with medicinal marijuana laws compared to the states that have not legalized it for medicinal use.[3]

In animal models, there is evidence that marijuana exerts anti-nociceptive effects.[4,5,6] However, the effectiveness of marijuana in the management of pain in human subjects remains unclear and controversial. To date, the evidence investigating the use of marijuana for pain management has focused largely on chronic pain or neuropathic pain. A recent systematic review of randomized controlled trials for its use in chronic pain suggests it is safe and modestly effective.[7] To our knowledge, there are no studies evaluating the perceptions of the musculoskeletal trauma population with regard to the utility of using marijuana in the management of post-injury and post-operative pain.

The primary purpose of this study is to evaluate musculoskeletal trauma patients' beliefs regarding the usefulness of marijuana as a valid medical treatment for post-injury and post-operative pain and anxiety. Secondly, we wish to establish if there is an association between

marijuana use post-injury and patient reported anxiety, symptoms of post-traumatic stress, and pain. We also seek to evaluate how many of our musculoskeletal trauma patients would be comfortable discussing marijuana use with their orthopaedic provider and moreover, how many of our patients are already utilizing marijuana during their recovery from injury.

Materials and Methods

We performed a prospective study of patients presenting to our trauma clinics at 2 ACS level 1 trauma centers in Massachusetts, a state with recently passed medical marijuana legislation. Patients were approached to complete a survey if they were between 1 and 6 months from either a musculoskeletal injury (treated with or without surgery) and were over the age of 18. 538 patients were approached to take the survey. There were 500 patients who successfully completed the survey, yielding a response rate of 93% (Figure 1).

The survey consisted of 35 questions (Appendix A). Participants were asked demographic and injury questions as well as about their perceptions of the validity of the use of marijuana in the treatment of medical conditions, pain, and anxiety. We also asked patients about any history of marijuana use, and specifically if they used it during their recovery. Of the patients who responded affirmatively that they used marijuana during their recovery, we asked them about their perception of whether marijuana contributed to an improvement in their pain and whether it decreased their need for opioid pain medication.

Patients were administered the PROMIS SF v1.0-Anxiety 4a instrument to evaluate their feeling of anxiety and worries.[8] For PROMIS instruments, the US population norm is a score of 50 with a standard deviation of 10. To evaluate catastrophic thinking regarding pain, patients were administered the Pain Catastrophizing Scale (PCS).[9] This is a 13 item instrument validated to identify patients with increased worries and problems coping with pain. Scores are summed,

and using a cut-off score of 30, respondents were classified as either having a clinically relevant level of pain catastrophizing (score ≥30) or not (score <30).[9] Patients were also administered the Short Screening Scale for DSM-IV Post-Traumatic Stress Disorder (PTSD) test, a 7 item survey of yes-no questions.[10] Patients who respond with yes to 4 or more questions are considered positive, demonstrating sings and symptom of PTSD and likely to suffer from PTSD.

Survey responses were collected directly into a REDCap database. Statistical analysis was performed in R 3.2.2.[11] Multiple logistic regression analysis was performed to evaluate the association of age, sex, type of injury, and the need for surgery as independent predictors of a patient's likelihood to believe that marijuana can be used as a medicine, can be helpful in treating pain, or can help to treat anxiety.

Results

A total of 500 patients completed the survey. Fifty percent (250) of the respondents were female. The median age was 55 years old, range 18 to 93 (Figure 2). Thirty-one percent (153) of patients had an injury that was treated non-operatively, while 69% (347) had surgery to treat their injury. Injury characteristics are presented in Table 1.

The majority of patients, 81% (405), believed that marijuana can be used as a medication, while 12% (62) were unsure and 7% (33) felt that it could not. The majority of patients felt that marijuana could be used to treat both pain (78%, 390) and anxiety (62%, 309) (Figure 3). In a multiple regression analysis, older patients were found less likely to believe that marijuana was a useful medication (OR 0.97 per year, $p<0.001$), could be used to treat pain (OR 0.98 per year, $p<0.001$), or could be used to treat anxiety (OR 0.97 per year, $p<0.001$). Sex ($p=0.38$), type of injury ($p=0.08$-$p=0.38$), and the need for surgery ($p=0.97$) were not predictive of a patient's belief of the usefulness of marijuana as a medical drug. The belief of a patient in the utility of

marijuana as a medication for treating pain or anxiety was not influenced by sex (p=0.26/p=0.63) or the need for surgery (p=0.73/p=0.20). Patients with multiple injuries were less likely to believe that marijuana could be used to treat anxiety (OR 0.42, p=0.01) compared to those with isolated lower extremity fractures.

Of the 500 patients who completed the questionnaires, the majority (60%, 302) of them have used marijuana at least once previously. A significantly lower number, 21% (107) reported that they used marijuana in the past year. Only 13.6% reported using marijuana during their recovery from their musculoskeletal injury either often (36 patients, 7.2%) or not often (32 patients, 6.4%). Of those that used marijuana during their recovery, 90% (63/70) believed that it reduced symptoms of pain; and 81% (57/70) believed that it reduced the amount of opioid pain medication they required (Figure 4). In patients that used marijuana, neither age (p=0.10), sex (p=1.0), injury (p=0.57), nor need for surgery (p=0.08), were significantly associated with a perceived reduction in pain level. In patients that used marijuana, neither age (p=0.21), sex (p=0.20), injury (p=0.60), nor need for surgery (p=0.25), were significantly associated with a perceived reduction in the need for prescription pain medication.

The median anxiety PROMIS score was 47 (range 40-81). This indicates that our patients with musculoskeletal trauma are similar to US population norms in terms of feelings of anxiety. Patients who used marijuana during their recovery had greater feelings of anxiety than those who did not (54.3 vs. 48.8, p<0.001). A total of 107 patients (21%) had a clinically relevant score of 40 or more on their Pain Catastrophizing Score (PCS). There was a trend toward patients having increased problems with catastrophic thinking in those that used marijuana during their recovery compared to those that did not (21.1 vs. 17.5, p=0.052). There were 99 patients (20%) who had a score of 4 or more on the PTSD scale, indicating signs of post-traumatic stress disorder. There

was no association between signs and symptoms of PTSD in those that used marijuana during recovery compared to those that did not (80/430 vs. 19/70; 19% p=0.13). There was moderate degree of correlation between patients with higher pain catastrophizing and PROMIS anxiety scores (Spearman correlation coefficient, 0.57), patients with higher pain catastrophizing and PTSD scores (0.55), and higher PROMIS anxiety and PTSD scores (0.58).

The majority, 84%, of respondents indicated that they would be either very comfortable (259), or comfortable (164) discussing medical marijuana with their healthcare provider. However, not as many patients were clear as to the legality of medicinal marijuana use in Massachusetts; 59% (294) of patients correctly knew that marijuana use for medical purposes was legal in Massachusetts. A similar number 55% (273) correctly identified that there were now legal dispensaries currently active. The use of marijuana for medical purposes has been legal in Massachusetts since January 1, 2013, with the first dispensary licensed on December 31, 2014.

Discussion

There has been significant debate within the United States as to the utility of medical marijuana. Despite federal prohibition many states have now passed laws allowing for the prescription of medical marijuana. The American Medical Association (AMA) does not promote or condone the use of medical marijuana but "urges that marijuana's status as a federal Schedule I controlled substance be reviewed with the goal of facilitating the conduct of clinical research and development of cannabinoid-based medicines, and alternative delivery methods."[12] It has been our experience that, since the legalization of medical marijuana in Massachusetts, there has been a large increase in the number of patients in our practice inquiring about the utility of using marijuana during their recovery. The goal of this study is to better understand the perceptions of the musculoskeletal patient population with regard to the usefulness of medical marijuana.

While the use, sale, and possession of marijuana is illegal in the United States under federal law, state laws vary.[13,14] The recreational use of marijuana is currently allowed in 4 states and Washington DC. Twenty-one additional states have laws allowing for the use of medicinal marijuana.[1] In Massachusetts, the use of marijuana for the treatment of medical conditions when recommended by a physician became legal in January 2013.[15] The first dispensaries were licensed on December 31st, 2014. Patients with a letter from a physician, and who have registered with the Department of Public Health (DPH) may grow marijuana for their own consumption and may possess a 60-day supply as defined by the Department of Public Health, or may legally purchase marijuana at a dispensary. To prescribe marijuana in the state of Massachusetts a physician must register with the DPH and must comply with the following criteria: have an active unrestricted medical license, have a MA controlled substances registration, have at least 1 established location of practice, and complete 2 hours of CME regarding the proper use, side effects, dosage, contraindications and substance abuse recognition related to marijuana.[16]

Marijuana is the most commonly used illicit drug in the United States. A survey performed by the Substance Abuse and Mental Health Services Administration in 2001 revealed that 41.9% of Americans have used marijuana at some point in their lives, while 11.5% have used marijuana within the last year.[17] A more recent survey, performed by the US Department of Health and Human Services in 2013 found that 7.6% of Americans aged 18 and over use marijuana regularly.[2] We found a moderately higher rate of marijuana use in our musculoskeletal trauma population than these studies of national norms (60% use at some point in the past, and 21% in the last year). It is likely that those with a history of illicit drug use and/or recent use are at higher risk of trauma than the general US population.[18] While there are no officially kept statistics of the number of patients using medical marijuana, one advocacy group tallied

approximately 1.1 million patients are “registered” to use marijuana in the 25 states with legal medical marijuana.[19] This accounts for approximately 7.7 people per 1000 state residents.

There is limited data available regarding the use of medical marijuana as an analgesic. The highest quality evidence available for the effectiveness of marijuana in pain management has been in the chronic pain patient population. A 2011 systematic review identified 18 randomized clinical trials conducted between 2003 and 2010 evaluating cannabis or cannabinoids for the treatment of non-cancer chronic pain.[7] Fifteen of the 18 trials found a statistically significant, albeit modest, improvement in pain levels in subjects.[20-37] Another beneficial effect of marijuana identified in several of the trials was improved sleep. However, many of these trials were conducted with small samples and the heterogeneity of patient populations and cannabinoid drug delivery makes generalizability difficult. There are 4 small studies looking at the use of medical marijuana in the treatment of neuropathic pain. Two of these deal exclusively with neuropathic pain in HIV patients, and show a benefit to the use of marijuana.[20,21] In one study of 23 adults with post-traumatic and post-operative neuropathic pain, the use of medical marijuana demonstrated a decrease in daily pain intensity, improved ability to fall asleep, and improved quality of sleep.[21] Another double-blind, placebo controlled study of 39 patients with chronic neuropathic pain found improved pain scores in patients receiving marijuana.[23] The effect size of marijuana in this study was similar to the published effect size of pregabalin (Lyrica®) and gabapentin (Neurontin®). Together, these 4 studies demonstrate a clear, although small, analgesic effect in patients with neuropathic pain with relatively mild side effects. To our knowledge, there are no direct studies of marijuana in treating post-injury or post-operative pain.

The potential for medicinal marijuana to mitigate the increasing opioid epidemic is a

large potential societal benefit of its use. In 2012, there were 16,007 unintentional deaths due to opioid analgesics (not including heroin) in the United States and since 1999, the age-adjusted rates of opioid-analgesic deaths have more than tripled.[38] Studies have shown a correlation between increased medical use/consumption of opioids and opioid-related mortality.[39] A recent study seeking to determine the association of mortality from opioid overdose with medical marijuana legislation has found that states with medical marijuana laws had a 24.8% lower mean annual rate of unintentional opioid overdose mortality compared to states without such legislation.[40] Acute overdose from marijuana alone is extremely uncommon; the estimated fatal dose of marijuana is 15 to 70g, which is well above what even a heavy recreational smoker would ingest.[41] It has been demonstrated that non-medical use of marijuana is not associated with increased non-AIDS mortality at a population-level.[42] The most common drug-related adverse effects with medicinal use of smoked marijuana have been reported to be headache, dry eyes, burning sensation, dizziness, numbness and cough and these side-effects are dose-dependent.[22, 41] Up to 9% of patients who experiment with marijuana can become addicted.[43] There is also a clear link between marijuana intoxication and the risk of motor vehicle collisions.[44] Other adverse events that have been associated with marijuana use include exacerbation of mental illness and psychosis, long-term cognitive dysfunction, and possible links to lung cancer, respiratory disease, and cardiovascular disease.[45]

Our study has identified that musculoskeletal trauma patients with recent marijuana use scored higher on the PROMIS anxiety instrument. There was a trend toward higher scores on the Pain Catastrophizing Score. It could be that patients with anxiety and worries are self medicating with marijuana. Conversely, it is possible that marijuana use is related to increased issues with anxiety and pain. There is evidence that marijuana use is increased in patients with mental

illness, although no cause and effect has been identified.[45] Signs and symptoms of PTSD were similar between those that used marijuana recently and those that did not.

As in any survey this study is limited by patients willingness to respond, and their perceptions. The topic of medical marijuana is controversial, and some people have strong feelings both for and against its use. Anecdotally, we found that patients were open to discussing their beliefs in either direction and the response rate was high (93%). Another limitation is that 31% of patients were treated non-operatively, and this group of patients may under represent the patient perception of improvement of pain control with medical marijuana. This survey also relied upon patient self-reporting in terms of their marijuana use and any effect on pain medications, and thus is potentially subject to reporting bias. Despite these limitations our results are in line with large national polls. In 2011, CBS polled 1025 adults living in the continental United Sates and found that 77% of people thought doctors should be able to prescribe marijuana for a "serious illness."[46] The Hawkeye Poll Cooperative at the University of Iowa conducted a similar poll in 2010, and found that 65% of Americans "favor legalization for medical use."[47] These results are similar to our respondents of whom 73% thought that marijuana was useful as a medicine. Further, 60% of respondents reported using marijuana at some point in their lives, again similar to national polling data reporting 42% lifetime usage.[14]

The role of medical marijuana in managing post-injury and post-operative symptoms of pain and anxiety is poorly understood. The majority of our patients indicated they were comfortable talking with their healthcare provider about medical marijuana. Further, a clear majority of patients in this study believed that medical marijuana is a valid treatment and that it does have a role in reducing post-injury and post-operative pain. Further, in the subset of patients who used marijuana during their recovery, a majority indicated that it helped alleviate symptoms

of pain and reduced their level of opioid intake. Undoubtedly, further investigation is required to parse out associations with the alleviation of pain nociception versus easing of psychological distress that can accompany injury and drive pain perceptions. Patients with recent marijuana use scored higher on the PROMIS anxiety instrument and there was a trend towards an increase in catastrophic thinking. As a cross sectional study, we cannot definitively correlate patients perceptions with an actual improvement in pain or a reduction in opioid use. Pain management should be regarded in a holistic manner and non-pharmacological measures such as coping strategies and development of self-efficacy also need to be explored further in the research. However, our results support further study into the utility of medical marijuana as a pain management adjunct in the orthopaedic trauma population.

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Figure Legend

Figure 1: Flow chart of patients approached, who completed the survey and those that were excluded from the analysis.

Figure 2: Age distribution of responding cohort.

Figure 3: Percentage of respondents who believe marijuana can be used as a medicine, can treat pain, and can be used for anxiety.

Figure 4: Percentage of patients who have used marijuana in the past, as well as the reported effect of marijuana use on post-injury pain and opioid use.

Appendix A: Survey administered to patients.

Thank you for taking the time to complete this survey. Please answer each question to the best of your ability.

1. Do you believe that marijuana can be used as a medicine?
   - ☐ Yes
   - ☐ No
   - ☐ I do not know.

2. Do you believe that marijuana can help in treating pain?
   - ☐ Yes
   - ☐ No
   - ☐ I do not know.

3. Do you believe that marijuana can help to treat anxiety?
   - ☐ Yes
   - ☐ No
   - ☐ I do not know.

4. Would you be comfortable with your doctor talking with you about medical marijuana to help treat your injuries?
   - ☐ Yes, very comfortable
   - ☐ Yes, comfortable
   - ☐ No, uncomfortable
   - ☐ No, very uncomfortable

5. Have you ever used marijuana?
   - ☐ Yes
   - ☐ No

6. If yes, have you used marijuana in the last year?
   - ☐ Yes
   - ☐ No
   - ☐ Not applicable to me

7. Did you use marijuana during your recovery from your injury and, if so, how often?

- ☐ Yes, I used marijuana often
- ☐ Yes, I used marijuana but not often
- ☐ No, I did not use marijuana during my recovery.

If you answered yes to Question 7, please answer these questions.

a. Using marijuana reduced my level of pain:

- ☐ Yes, I very much agree.
- ☐ Yes, I agree.
- ☐ I do not agree and I do not disagree.
- ☐ No, I disagree
- ☐ No, I very much disagree.

b. Using marijuana reduced my need for prescription pain medication.

- ☐ Yes, I very much agree.
- ☐ Yes, I agree.
- ☐ I do not agree and I do not disagree.
- ☐ No, I do not agree.
- ☐ No, I strongly disagree.

8. Is medical marijuana legal in the state of Massachusetts?

- ☐ Yes
- ☐ No
- ☐ I do not know.

9. Is medical marijuana available in the state of Massachusetts?

- ☐ Yes
- ☐ No
- ☐ I do not know

Everyone experiences painful situations at some point in their lives. Such experiences may include headaches, toothaches, joint or muscle pain. People are often exposed to situations that may cause pain such as illness, injury, dental procedures, or surgery. We are interested in the types of thoughts and feelings that you have when you are in pain. Listed below are thirteen statements describing different thoughts and feelings that may be associated with pain. Using the following scale, please indicate the degree to which you have these thoughts and feelings when you are experiencing pain.

1. When I'm in pain ... I worry about whether the pain will end

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

2. When I'm in pain... I feel I can't go on

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

3. When I'm in pain... It's terrible and I think it's never going to get any better

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

4. When I'm in pain... It's awful and I feel that it overwhelms me

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

5. When I'm in pain... I feel I can't stand it anymore

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

6. When I'm in pain... I become afraid that the pain will get worse

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

7. When I'm in pain... I keep thinking of other painful events

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

8. When I'm in pain... I anxiously want the pain to go away

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

9. When I'm in pain... I can't seem to keep it out of my mind

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

10. When I'm in pain... I keep thinking about how much it hurts

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

11. When I'm in pain... I keep thinking about how badly Iwant the pain to stop

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

12. When I'm in pain... There's nothing I can do to reduce the intensity of the pain

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

13. When I'm in pain... I wonder whether something serious may happen

Not at all
To a slight degree
To a moderate degree
To a great degree
All the time

These next questions will ask you about certain situations you may have encountered after your injury. The "experience" we speak of in these questions refers to your injury.

1. Did you avoid being reminded of this experience by staying away from certain places, people, or activities?
   Yes
   No

2. Did you lose interest in activities that were once important or enjoyable?
   Yes
   No

3. Did you begin to feel more isolated or distant from other people?
   Yes
   No

4. Did you find it hard to have love or affection for other people?
   Yes
   No

5. Did you begin to feel that there was no point in planning for the future?
   Yes
   No

6. After this experience were you having more trouble than usual falling asleep or staying asleep?
   Yes
   No

7. Did you become jumpy or get easily startled by ordinary noises or movements?
   Yes
   No

1. In the past 7 days, I felt fearful

Never
Rarely
Sometimes
Often
Always

2. In the past 7 days. I found it hard to focus on anything other than my anxiety

Never
Rarely
Sometimes
Often
Always

3. In the past 7 days, my worries overwhelmed me

Never
Rarely
Sometimes
Often
Always

4. In the past 7 days, I felt uneasy

Never
Rarely
Sometimes
Often
Always

Table

Table 1. Patient demographic information and injury characteristics.

Variable	Total Cohort (n=500)
Age median (range) yrs	 55 (18-93)
Sex Female (%) Male (%)	 250 (50%) 250 (50%)
Treatment Surgical Non-Operative	 347 (69%) 153 (31%)
Pelvis/Lower Extremity	334 (67%)
Upper Extremity Fracture	101 (20%)
Multiple Fractures	49 (10%)
Soft Tissue Injuries	16 (3%)