Patients value their own pain over braking safety when deciding when to return to driving: a discrete choice experiment on lower extremity injuries

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Abstract
Objective: To quantify patient preferences towards time to return to driving relative to compromised reaction time and potential complication risks.
Design: Cross-sectional discrete choice experiment.
Setting: Academic trauma center.
Patients: Ninety-six adult patients with an operative lower extremity fracture from December 2019 through December 2020.
Intervention: None.
Main Outcome Measurement: Patient completed a discrete choice experiment survey consisting of 12 hypothetical return to driving scenarios with varied attributes: time to return to driving (range: 1 to 6 months), risk of implant failure (range: 1% to 12%), pain upon driving return (range: none to severe), and driving safety measured by braking distance (range: 0 to 40 feet at 60 mph). The relative importance of each attribute is reported on a scale of 0% to 100%.

Results: Patients most valued a reduced pain level when resuming driving (62%), followed by the risk of implant failure (17%), time to return to driving (13%), and braking safety (8%). Patients were indifferent to returning to driving at 1 month (median utility: 28, interquartile range [IQR] = 31 to 80) or 2 months (median utility: 59, IQR: 41 to 91) postinjury.

Conclusion: Patients with lower extremity injuries demonstrated a willingness to forego earlier return to driving if it might mean a decrease in their pain level. Patients are least concerned about their driving safety, instead placing higher value on their own pain level and chance of implant failure. The findings of this study are the first to rigorously quantify patient preferences toward a return to driving and heterogeneity in patient preferences.

Level of Evidence: V
Keywords: braking safety, driving safety, implant failure, lower extremity, pain, patient preferences, return to driving

1. Introduction
Patients commonly ask their physician when they can return to driving after management of a lower extremity fracture. While broadly accepted return to driving guidelines for lower extremity fracture patients are lacking; simulation studies, meta-analyses, and editorials summarizing the evidence are available. Several studies have been conducted to explore patients’ driving performance after orthopaedic procedures of lower extremity injuries, focusing on the patient’s brake reaction time (BRT) returning to normal. Although BRT is an important measure...
of an individual’s ability to drive, studies have also shown that even when BRT has returned to normal, other factors such as pain and range of motion can prevent patients from driving. Medicolegal implications should also be considered, since physicians are often legally responsible for advising patients about a disability that might endanger society. In a survey of orthopaedic surgeons, Chen et al found that 68% of surgeons reported feelings of unease about telling patients to return to driving, and 44% reported concerns about potential litigation in the event that a patient was involved in a motor vehicle collision upon returning to driving. The decision is ultimately left to the patient to return to driving when they feel it is safe.

With limited guidance in the decision-making process, understanding patient concerns and the demographic factors associated with differential concerns can improve value-based care. To our knowledge, existing studies have not yet examined patient preferences for return to driving. The purpose of this study was to identify patient preferences towards time to return to driving, determine preference heterogeneity among respondents, and examine acceptable trade-offs of potential complications related to these different time points.

2. Materials and methods

2.1. Study design

A discrete choice experiment (DCE) was prospectively administered to patients with an operative lower extremity orthopaedic trauma at a level I trauma center. DCEs are regularly used in healthcare to determine individual preferences by presenting individuals with a survey containing several hypothetical choice sets or scenarios, each with 2 or more options. Respondents choose their preferred option, which are described with fixed attributes and varying levels in each choice set. The data collected is analyzed to estimate the importance of each attribute, acceptable trade-offs between attributes, and total satisfaction or utility that patients place on each attribute.

2.2. Study setting and population

The study received approval by the local institutional review board and written informed consent was obtained as required for all enrolled patients. All adult (≥18 years), English-speaking patients with an operative lower extremity fracture were assessed for eligibility from December 2019 through December 2020. Eligible patients were enrolled in the study as inpatients or at an outpatient follow-up appointment. All patients provided informed consent prior to their inclusion in the study.

2.3. Questionnaire development

The DCE’s attributes and their corresponding levels were selected based on a literature review, expert consultation, and a retrospective review of patient outcomes. Patients chose between 2 return to driving options that vary in 4 attributes: time to return to driving, risk of implant failure within 6 months of driving, pain level, and braking distance.

| Scenario 1: Of these two options, which do you prefer? Check one option. |
|--------------------------------------------------|
| Option A | Option B |
| How long will it take to return to driving | 2 months after injury | 2 months after injury |
| Chance of hardware failure within 6 months of driving | 1% | 8% |
| Pain level after you start driving | Mild Pain | Moderate Pain |
| Additional distance traveled by vehicle before braking when driving speed is 60 mph | 40 feet | 0 feet |

Figure 1. Example choice set from the discrete choice experiment survey administered to participants. In each choice set, the values for each hypothetical return to driving option are varied.
We performed hierarchical cluster analysis to determine the number of clusters in our sample that best predict preference heterogeneity among respondents. Based on the cubic cluster criterion, we selected 2 clusters for our sample. We reported all patient characteristics by cluster to evaluate differences by cluster membership.

### 3. Results

Of the 123 respondents enrolled, only 96 passed the internal comprehension check and were included in the final analysis. Table 1 describes the patients who completed the survey. Of the 96 patients, the mean age was 41 years (standard deviation, 15), 56% were male, and 59% were White. The majority of participants were working before the injury (73%) and lived with others (96%). A significant percentage of participants were married (40%) and had dependents (33%). Over one-third of respondents were college educated (36%), and the median household income was $45,000 (interquartile range [IQR]: $35,000 to $75,000). Nearly one-half of the participants had other available transportation (49%) at the time of survey administration.

The attribute with the greatest relative importance to patients’ return to driving was reduced pain level (62%). This was distantly followed by the risk of implant failure (17%), and time to return to driving (13%) (Fig. 2). Braking safety (8%) was the least important attribute to patients when resuming driving.

The parameter estimates of utilities for each attribute and their associated levels are shown in Supplemental Digital Content Table 2, http://links.lww.com/OTAI/A56. Attributes with a positive median utility parameter indicated improved patient satisfaction, whereas attributes with a negative median utility parameter would reduce patient satisfaction. Signs of the parameter estimates appeared as expected with increased pain level and risk of implant failure having a negative utility. Earlier return to driving and decreased pain level had a positive utility. The highest parameter estimates were for “No Pain” when resuming driving (median utility: 186, IQR 129.7 to 210), followed by “Mild Pain” when resuming driving (median utility: 129.8, IQR 86.7 to 144.9) and a “1%” risk of implant failure (median utility: 80.9, IQR 44.6 to 124.6). “Severe Pain” when resuming driving (median utility: –315.9, IQR –354.8 to –180.1) distantly followed by “12%” risk of implant failure (median utility: –59.3, IQR –124.1 to 16.1) were the lowest parameter estimates.

Based on cubic cluster criterion in the hierarchical clustering analysis, 2 clusters were identified from our sample that differed in their preferences. Forty respondents (42%) were members of cluster 1 and 56 (58%) were members of cluster 2 (Supplemental Digital Content Table 3, http://links.lww.com/OTAI/A57). Cluster 1 membership had a higher proportion of male respondents (68% vs 48%). Respondents in cluster 1 were also more likely to have lower educational attainment (college degree: 28% vs 43%). Cluster 1 members placed increased importance on returning to driving sooner (relative importance: 29% vs 9%) and a compromised reaction time (18% vs 6%). Cluster 2 members...
were more concerned with increased pain level attributable to driving (61% vs 36%) (Fig. 3).

Cluster 2 members had more negative utility associated with pain level compared to cluster 1 members, with the largest difference in the “Severe Pain” level (median utility, $-338.8$ vs $-150.7$), showing high importance in avoiding increased pain (Fig. 4). Cluster 2 members also had lower utility associated with increased risk of implant failure, with the largest difference in the “12%” level (median utility, $-104.6$ vs $1.7$).

4. Discussion

Our study indicates that patients with lower extremity orthopaedic trauma demonstrate a strong willingness to forego earlier return to driving if it could mean decreased pain level. When considering
return to driving, patients place the greatest relative importance on pain level and chance of implant failure. Furthermore, patients are least concerned about driving safety, placing the least relative importance on braking function. Additionally, patient factors such as sex and level of education led to heterogeneity in patient preferences. Hierarchical clustering analysis identified 2 clusters that differed in their preferences. The cluster with higher education level and predominately female were willing to delay their return to driving to avoid a pain increase. The cluster with lower education level and predominately male were more concerned with impaired braking function and preferred a shorter return to driving.

To our knowledge, this is the first study to quantify patient preferences toward a return to driving using the DCE methodology. Previous studies on driving typically have focused on factors such as the brake response time by utilizing a driving simulator. A 2018 prospective clinical study investigating return to car driving after operative treatment of right ankle fractures, used a stationary reaction timer consisting of a computer screen and an external driving simulator to measure break reaction time at three postoperative time points. However, brake response time might not be the best estimator of driving ability considering the numerous effects that orthopaedic injuries and operations can have on a patient’s return to driving. Pain and range of motion have been shown to significantly affect driving ability and safety. A patient could demonstrate a normal brake response time soon after orthopaedic surgery but might still be taking narcotic analgesics for postoperative pain and would not be ready to operate a vehicle. Our findings did demonstrate a strong patient preference for lower pain levels when returning to driving, although it did vary by sex and education level. The risk of implant failure was a secondary concern for patients and possibly correlated with weightbearing and fracture healing concerns. This apprehension may be mitigated through patient education, contextualizing the likelihood of implant failure upon a return to driving. The multitude of factors to consider when advising on a return to driving timeline includes side of injury, type of surgical procedure, limb immobilization, pain level, range of motion, narcotic medication use, and ability to brake. These considerations should be discussed between the surgeon and the patient, with each decision to return to driving being made on a case-by-case basis.

The study had several limitations. Although the DCE design quantifies patient preferences among subgroups, it does not provide the means for qualitative analysis of preferences. Therefore, we could only speculate as to the reasons behind the value patients placed on certain attributes compared to others. Additionally, the validity of the results relies on the assumption that the respondents understood the choice sets, as intended. It is possible that patients may have had less understanding of the importance of braking distance as it relates to driving safety and therefore placed less value on it, whereas the other factors were more easily understood by this patient population. Another limitation of this study is the analysis of patients’ stated preferences to hypothetical choice sets, meaning their actual choices might be different. In addition, respondents were recruited at various timepoints within their first few months after injury. It is possible that some patients were counseled on returning to driving prior to completing the survey. While this study was not designed to assess the impact of these external factors, previous research has demonstrated that patient recovery preferences remain relatively robust during the first 12 months after injury. We did not collect data on the type or severity of the lower
extremity fracture and are, therefore, unable to investigate preference variation and are, these factors. Our study excluded non-English speaking patients, which may limit the generalizability of the results. Finally, 27 patients failed the internal comprehension check of the survey, and following best practices, we excluded these responses from the main analysis. However, our results did remain robust to their inclusion.

With the current focus on patient-centered care, the importance of incorporating patient preferences and values when developing guidelines or care models to deliver quality and cost-effective healthcare has never been greater. A Driver Fitness Medical Guidelines statement was issued by the American Association of Motor Vehicle Administrators in conjunction with the National Highway Traffic Safety Administration, but the only orthopaedic procedure with a recommendation for return to driving at 4 to 6 weeks was anterior cruciate ligament surgery. The lack of guidelines for other orthopaedic injuries along with the medicolegal considerations for clinicians will continue the push for high-quality research that provides surgeons with evidence-based recommendations for their patients.

In conclusion, this study elicited patient preferences for return to driving after sustaining a lower extremity orthopaedic injury. When presented with varying levels of postoperative complications or braking function, patients strongly preferred lower levels of pain when resuming driving and placed the least value on braking function. Surgeons and other healthcare providers should recognize the paramount importance of pain upon return to driving when counseling their patients. Further, the study identifies a subset of patients who were willing to tolerate moderate levels of pain to return to driving faster. Future study designs aimed at forming clinical guidelines for safe and efficient return to driving should focus on attributes that patients place the most value. These patient values are of interest to orthopaedic surgeons to guide clinical decisions and improve patient satisfaction.

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