




BMJ Open Patients' preferences for occupational therapy after upper extremity fractures: a discrete choice experiment

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ABSTRACT

Objective Occupational therapy is often prescribed after the acute treatment of upper extremity fractures. However, high out-of-pocket expenses and logistical constraints can reduce access to formal therapy services. We aimed to quantify preferences of patients with upper extremity fracture for attending occupational therapy, when considering possible differences in clinical outcomes.

Design Discrete choice experiment.

Setting Level 1 trauma centre in Baltimore, Maryland, USA.

Participants 134 adult patients with upper extremity fractures.

Primary outcome measures The scenarios were described with five attributes: cost, duration of therapy session, location of therapy, final range of motion and pain. We report the relative importance of each attribute as a proportion of total importance, and the willingness to pay for benefits of the therapy services.

Results Of the 134 study participants, the mean age was 47 years and 53% were men. Cost (32%) and range of motion (29%) were the attributes of greatest relative importance. Pain (17%), duration of therapy (13%) and location of therapy (8%) were of lesser importance. Patients were willing to pay \$85 more per therapy session for a 40% improvement in their range of motion. Patients were willing to pay \$43 more per therapy session to improve from severe pain to mild pain. Patients were indifferent to whether the therapy treatment was home-based or in a clinical environment.

Conclusions When deciding on an upper extremity fracture therapy programme, out-of-pocket costs are a paramount consideration of patients. Improvements in range of motion are of greater importance than residual pain, the duration of therapy sessions and the location of service provision. Patients with upper extremity fracture should be prescribed occupational therapy services that align with these patients' preferences.

INTRODUCTION

Upper extremity fractures make up approximately 590 000 fractures annually, yielding an incidence rate of over 67 fractures over 10 000 people.¹ Initial management consists of operative or non-operative orthopaedic treatment and a period of immobilisation.

Strengths and limitations of this study

- This is the first study to quantify patients' preferences regarding postoperative occupational therapy after upper extremity fracture.
- Patients' preferences results can be used to develop more personalised therapy regimens for greater accessibility.
- Given the directionality, magnitude and the consistency of the responses, high-faced validity is demonstrated.
- The choice sets presented preferences to respondents to hypothetical scenarios, and the respondent's actual choices may be different.

Consequently, the presence of pain, stiffness, weakness and swelling impairs patients' participation in activities of daily living. Rehabilitation therapy is regularly prescribed to address the pain and functional limitations that occur following the surgical fixation of an upper extremity fracture.² Exercise therapy is integral to key principles of fracture management, including motion of adjacent joints and muscle activation. Multiple studies have directly linked exercise therapy programmes to improved range of motion after upper extremity fracture.^{3 4} However, adherence to the prescribed formal therapy services is limited due to high out-of-pocket expenses and logistical constraints.⁵ Additionally, an increasing number of orthopaedic studies exhibited equivalent outcomes in a home-based therapy programme compared with a formal supervised therapy programme.^{2 4 6-19} Further, recommendations for the type, intensity and duration of postoperative exercise therapy lacks consensus.

Aside from therapy characteristics, individual patient's characteristics (such as socioeconomic status, environmental factors and general physical health) have been associated with adherence rates and determinants of

engagement in physical activity.^{20–22} Other studies have suggested that exercise regimens that are individually tailored, trainer led and high intensity lead to improved adherence rates.^{23–24} Thus, therapy characteristics and individual factors could inform clinicians about patients' preferences to therapy when respondents are presented with two more alternatives.²⁵

Incorporating patients' preferences into clinical decisions can lead to improved patient outcomes.^{26–27} Physicians have previously underestimated the desire of patients to be involved in their own care and the satisfaction gained from being heard.^{28–29} Clinical decision-making that respects patients' preferences increases healthcare effectiveness.^{30–31} Patients' preferences can be determined quantitatively through choice modelling techniques, such as discrete choice experiments (DCEs).

DCEs can be used to quantify the trade-offs individuals take into consideration when making a decision. The purpose of this study was to determine the patients' preferences for occupational therapy after sustaining an upper extremity fracture. In addition to characterising patients' preferences, we calculate the respective willingness to pay to better understand trade-offs in therapy regimens. This study only assessed patients' preferences and did not evaluate the effectiveness of the hypothetical therapy regimens.

METHODS

Discrete choice experiment

We prospectively administered a DCE to orthopaedic trauma patients at a level 1 trauma centre. DCEs are used in healthcare as a quantitative technique to measure individual preferences by administering surveys that ask individuals to choose the best option between two or more hypothetical scenarios and choice sets.^{32–34} Options are defined with a fixed set of attributes and corresponding levels that vary in each scenario. From the scenarios, the data collected can be used to calculate the relative importance of each attribute and acceptable trade-offs among attributes. The inclusion of cost allows estimation of individuals' willingness to pay for changes in levels within an attribute.

Study setting and population

This study was conducted at the R Adams Cowley Shock Trauma Center in Baltimore, Maryland. All adult (>18 years) patients treated with upper extremity fractures, including distal radius, radius and ulna shaft fractures in combination or isolation, olecranon process, distal humerus and humeral shaft fractures were assessed for eligibility from February through August 2019. All patients were treated operatively within 4 weeks of injury. Postoperative patients with isolated upper extremity fractures were enrolled in the study at an outpatient follow-up appointment. Bilateral upper extremity injuries and ipsilateral concomitant upper extremity injuries were excluded.

Table 1 Attributes and levels included in the discrete choice experiment

Attributes	Levels
Type of therapy	Independent home therapy, formal occupational therapy
Cost of therapy (total) (\$)	0, 120, 300, 1200
Duration of therapy session (min)	5, 15, 45, 60
Pain level after completing therapy	Mild, moderate, severe
Range of motion after completing therapy	Normal, 10% loss of motion, 20% loss of motion, 40% loss of motion

Study design

The development of the attributes and their corresponding levels used in our DCE was based on literature review, patient interviews and expert consultation. Therapy practice patterns suggest that patients are often referred to formal occupational therapy for rehabilitation services in order to decrease pain, improve range of motion and recover function.³⁵ Multiple prospective trials found self-directed home-based exercises to be comparable to formal occupational therapy after distal radius fractures.^{12–13} Approximately 20–30 informal patient interviews were conducted in the office setting asking reasons for attending and barriers to the therapy. Based on the literature review and patient interviews, three fellowship trained upper extremity surgeons agreed on nine initial attributes. We refined the attributes through a 20-patient pilot DCE where qualitative patients' feedback suggested the removal of attributes pertaining to the number of therapy visits, recovery time, travel time to therapy and activities of daily living. Additionally, this allowed us to test our range of motion pictures, which were well received and easy to understand. The final questionnaire included five attributes: type of therapy, total cost for therapy, duration of therapy session, pain level after completing therapy and loss of range of motion after completing therapy (table 1).

We developed a survey with 12 distinct choice sets using the Choice Modelling platform in JMP Pro V.14 (Cary, North Carolina, USA). The design optimised D-efficiency in that the variation in attribute comparisons was maximised while the respondent burden was minimised. Patients chose between two hypothetical therapy options that varied in five attributes. The total cost was based on out-of-pocket co-pay of \$0, \$10, \$25 or \$100 for once-a-week therapy for 12 weeks. To make the math easier for the patients, we did a cumulative total cost of therapy for the 12 weeks of therapy in the DCE scenarios. For instance, if the cost would be \$10 per therapy session then the DCE option would be \$120 of total therapy cost. Range of motion was based on the percentage lost compared with baseline. Pain was described as residual pain after completion of therapy. The DCE included two location options for the therapy to occur: either at

Scenario 5: Of these two options, which do you prefer? Check **one** option.

	Option A	Option B
Type of Therapy	Independent Home Therapy	Formal Occupational Therapy
Total Cost for Therapy	\$0	\$300
Duration of Therapy Session	60 minutes per session	15 minutes per session
After therapy, your function will be:		
Pain Level	Severe Pain	Mild Pain
Range of Motion	 10% Loss of Motion	 20% Loss of Motion
Check one	Prefer Option A <input type="checkbox"/>	Prefer Option B <input type="checkbox"/>

Figure 1 Sample scenario from the discrete choice experiment administered to participants.

the therapy office with a therapist or independently at home. **Figure 1** displays the format in which participants received the choices. We created three different versions of the survey that depict a range of motion image specific to the patient's location of injury. Olecranon process, distal humerus and humeral shaft fractures received the

elbow flexion/extension version of the survey. Radial and ulnar shaft fractures received the pronation/supination version of the survey. Distal radius fractures received the wrist flexion/extension survey. A member of the research staff was available for questions as the study participant completed the survey. The DCE was augmented with patient-reported demographic data, including age, sex, race, education status, living arrangement, supporting dependent status, pre-injury work status and income, and health insurance status. Patients' addresses were used to calculate the Area Deprivation Index (ADI) quartile for each patient. The included attributes and levels are available in [table 1](#).

Patient and public involvement

DCEs are designed to measure patients' preferences in hypothetical clinical scenarios. Our study design included informal patient interviews and a 20-patient pilot to reduce the number of attributes. Our research team conducted this study with no patient involvement in recruitment. The results of the study will be published in a scientific journal that can be given to participants.

Statistical analysis

The demographic and clinical characteristics of the respondents were described using means and SDs for continuous variables and frequencies with proportions for categorical variables. Patients' preferences for the included attributes were determined using a multinomial logit model. The relative importance of each attribute level was determined by constructing a ratio with the numerator equal to the difference between the maximum coefficient and the minimum coefficient within the levels of a particular attribute. The denominator of the ratio is the sum of the values obtained in the numerator for all the attributes. This process normalises the scores to sum 100%. The willingness to pay for each of the non-cost attributes was determined using marginal rates of substitution.³⁶ Cost preferences are assumed to be linear in the willingness to pay analysis.

We explored patient factors associated with heterogeneity in the relative importance of each of the included attributes. Separate models were developed for each of the five attributes. The sample size provided over 80% power to test six factors with an estimated effect size of $f^2=0.10$. The candidate covariates included race, education status, pre-injury work status, health insurance status, ADI quartile and the type of injury. In each model, we applied a double least absolute shrinkage and selection operator (LASSO) regression technique based on an Akaike information criterion validation. Double LASSO regression shrinks non-influential coefficients to zero and then scales the remaining covariates. This method of penalised regression is robust under conditions of non-normality and minimised type I error. The absolute difference in the relative importance of the recovery domain associated with each remaining covariate is reported for

Table 2 Characteristics of respondents (n=134)

Characteristic	N=134
Sex (male), n (%)	71 (53.0)
Age (years), mean (SD)	46.5 (18.1)
Race, n (%)	
White	82 (61.2)
African-American	38 (28.4)
Other	14 (10.4)
Education, n (%)	
High school or less	53 (39.5)
Some college or more	81 (60.4)
Living arrangement, n (%)	
Live alone	25 (18.8)
Live with relatives/friends	108 (81.2)
Dependents (yes), n (%)	39 (29.1)
Working prior to injury, n (%)	87 (64.9)
Pre-injury annual income, median (IQR)	\$35 000 (\$15 000–\$65 000)
Full health insurance coverage (yes), n (%)	115 (85.8)
Area Deprivation Index, n (%)	
Most deprived quartile	14 (10.5)
3rd quartile	18 (13.5)
2nd quartile	39 (29.3)
Least deprived quartile	62 (46.7)
Type of injury, n (%)	
Elbow	68 (51.5)
Pronation/supination	18 (13.6)
Wrist	46 (34.5)

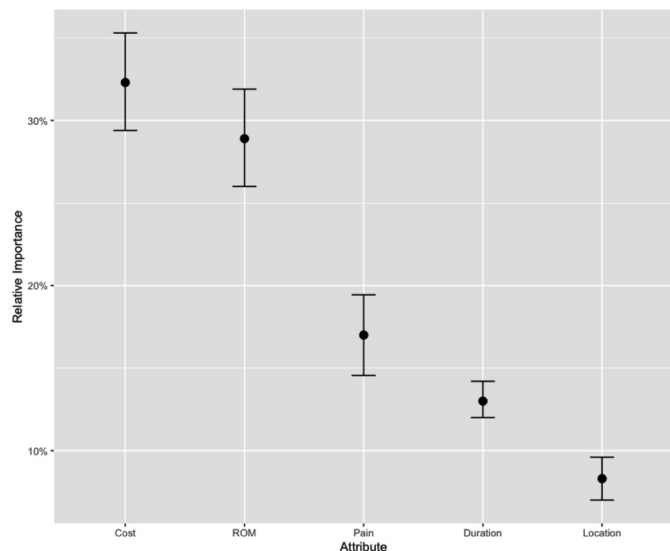


Figure 2 Relative importance of attributes. ROM, range of motion.

each of the five attribute models. All statistical analyses were performed with JMP Pro V.14.

RESULTS

We screened 213 patients for participation in the study. Thirty-three patients were deemed ineligible, and 46 patients declined participation. Of the 134 patients included in the analysis, the mean age was 46.5 years (SD; 18.1), 53.0% were men and 61.2% were white. The majority of the patients sustained an elbow injury (51.5%), had some college education (60.4%) and were fully insured (85.8%) (table 2).

Overall, the attribute with the greatest relative importance to patients with upper extremity fracture was total cost of therapy (32%), followed by range of motion (29%) and

pain (17%). The location of the therapy (8%) was the least important attribute included in our model (figure 2).

We report the willingness to pay per therapy session for each included attribute level in table 3. All else being equal, patients were willing to pay \$85 more per therapy session for a 40% improvement in their range of motion. Improving from a 10% range of motion deficit relative to pre-injury to regaining full range of motion was valued at \$9 more per therapy session. Patients were willing to pay \$43 more per therapy session to improve from severe pain to mild pain, and \$13 more dollars per therapy session to improve from moderate to mild pain. Overall, patients do not monetarily value performing the therapy at home versus at the therapist office.

We observed heterogeneity in the patients' relative importance of cost, range of motion and the location of services (table 4). The relative importance of cost was 12% (SE: 4) lower for patients with health insurance and 7% (SE: 3) lower for patients with at least a college education. Living in a neighbourhood of low deprivation was also associated with a reduced relative importance of the cost of therapy (1st quartile vs 4th quartile: -6% (SD: 4) and 2nd quartile vs 4th quartile: -9% (SE: 4)). In contrast, having health insurance increased in the relative importance of range of motion by 7% (SE: 3). Patients with a college education or higher (8%, SE: 3) and living in an area of low deprivation (2nd quartile vs 4th quartile: 5% (SE: 3)) also placed an increased importance on range of motion. The location of therapy services was of greater importance for patients with a college education or higher (2%, SE: 1) and living in an area of low deprivation (2%, SE: 1).

DISCUSSION

To our knowledge, this is the first study to quantify patients' preferences towards occupational therapy after sustaining an upper extremity fracture. Postoperative therapy is prescribed with the intention of facilitating functional gains and preventing long-standing disability.² Exercise therapy is integral to key principles of fracture management, including motion of adjacent joints and muscle activation. Multiple studies have directly linked exercise therapy programmes to improved range of motion after upper extremity fracture.^{3,4} Additionally, supervised therapy includes added benefits of coaching, live feedback, task-specific training and various treatment modalities like thermal or massage.³⁷ This study aimed to assess occupational therapy preferences of patients with upper extremity fracture.

Our results suggest that patients prioritise cost of therapy and final range of motion when considering a postoperative occupational therapy regimen. One can therefore assume that these study participants understand potential benefits of greater range of motion and that they associated greater range of motion with 'better outcomes'. This is further supported by the willingness to pay analysis, which demonstrated that patients were willing to pay an additional \$85 more per therapy session for a 40% improvement in their range of motion. Clinically, treating physicians know that even

Table 3 Willingness to pay (WTP) in dollars more per therapy session for included attribute levels

Attribute	Level	WTP (\$)	Lower 95%	Upper 95%
Range of motion, degrees less than pre-injury range	0°	84.8	70.7	98.9
	10°	76.2	62.5	89.9
	20°	51.5	38.8	64.1
	40°	Reference (0.0)		
Pain	Mild	43.2	34.1	52.4
	Moderate	29.6	21.7	37.5
	Severe	Reference (0.0)		
Duration of visit each therapy visit (min)	5	Reference (0.0)		
	15	7.0	-1.6	15.6
	45	28.0	18.3	37.7
	60	18.9	8.9	28.9
Location of therapy	Home-based	Reference (0.0)		
	Clinic	-0.5	-10.5	9.6

Table 4 Factors associated with heterogeneity in the relative importance of the attributes (SE)

Factor	Cost model	ROM model	Pain model	Duration model	Location model
Intercept	0.33 (0.04)	0.34 (0.03)	0.17 (0.1)	0.14 (0.01)	0.04 (0.01)
Health insurance (yes)	-0.12 (0.4)	0.08 (0.03)	-	-	-0.03 (0.01)
Education (college or more)	-0.07 (0.03)	0.08 (0.03)	-	-	0.02 (0.01)
ADI (1st–4th)	-0.06 (0.04)	-	-	-0.01 (0.01)	0.04 (0.01)
ADI (2nd–4th)	-0.09 (0.04)	0.05 (0.03)	-	-	-
Working pre-injury	-	0.05 (0.03)	-	-	-
Injury (pronation/supination to wrist)	-	-0.12 (0.03)	-	0.03 (0.02)	0.04 (0.02)
Injury (elbow to wrist)	-	-	-	-	0.02 (0.01)
Race (white to black)	-	-	-	-	0.03 (0.02)
R ²	0.17	0.15	-	0.06	0.16

A set of candidate covariates was considered for each model. These covariates included race, education status, pre-injury work status, health insurance status, Area Deprivation Index (ADI) quartile and the type of injury. The factors included in the final model were selected using a double least absolute shrinkage and selection operator regression and Akaike information criterion validation. The R² statistic represents the proportion of the variance for a dependent variable that is explained by the factors included in each model. ROM, range of motion.

with the highest quality of therapy, there is never a guarantee of return to baseline with any traumatic injury. Additionally, we do acknowledge that all magnitudes of improvement in range of motion in many joints do not translate directly into improved outcomes. However, this data highlight the patient's importance of the range of motion attribute and returning to work or daily activities.

We recognise that mild, moderate and severe pain is difficult for patients to quantify and this could impact the result. However, our results demonstrated that patients were willing to pay \$43 more per therapy session to improve from severe pain to mild pain. This information provides insight for future occupational therapy research and importance of pain to the patient as an outcome measure. A 45-minute therapy session was valued above 60 min, 15 min and 5 min of therapy. This finding suggests a subjective plateauing benefit from the patient's perspective with regards to the duration of therapy. While further research is required to confirm this effect, condensed therapy regimens may improve patients' engagement.

Our subgroup analysis suggests significant variation in preferences based on patients' educational attainment, health insurance status and socioeconomic status of their neighbourhood. Specifically, patients with high educational attainment, health insurance and living in low-deprivation neighbourhood place a much lower importance on the cost of therapy but have an elevated value towards regaining pre-injury function. However, patients of lower socioeconomic status and no health insurance value cost of therapy because the cost of therapy likely creates a higher financial burden leading to lower attendance. Patients with a college education and living in a low-deprivation neighbourhood also place an increased importance on therapy in a clinical environment. This could indicate that patients with lower education and living in high-deprivation areas are more interested in a home therapy because of difficulty with transportation to

therapy. This information is important to designing therapy regimens that are responsive to patients' preferences.

Interestingly, the results demonstrated that the location in which the therapy is being performed is of minimal importance to patients. With occupational therapy at the therapist office, the healthcare systems sustain costs resulting from insurance coverage and patients' treatment fees to caregivers' time for transportation. Home exercise therapy is an alternative treatment method that has grown in popularity where patients are taught how to perform the exercises unsupervised. The literature has not demonstrated formal occupational therapy to be superior to self-directed home therapy. However, an increasing number of orthopaedic studies exhibited equivalent outcomes in a home-based therapy programme compared with a formal supervised therapy programme.^{2 4 6–19 38} Yet, in our subgroup analysis, patients of higher educational attainment and living in low-deprivation communities prefer therapy at the therapist office as compared with home. This may indicate that patients feel they are getting more value by maximising their interaction with a healthcare professional through a more focused programme. Future studies should investigate and compare these two types of therapies in the population with upper extremity fracture.

The study has several strengths. The patients' reported preferences are actionable in the development therapy regimens and the design of future trials. Therapy can be a substantial economic burden to patients. If we assume that cost influences accessibility to therapy and that accessibility to therapy in turn influences health outcomes, then patients' preferences should be taken into consideration by providers when prescribing an occupational therapy regimen. For instance, providers could develop standardised home therapy regimens for patients who experience cost barriers. This would likely enhance individual patient's satisfaction and accessibility to the therapy regimen. Second, we used two-step

approach to establish the attributes and levels used in this experiment. The first step derived potential attributes and levels based on a literature search and expert group discussions. Subsequently in step 2, we used a pilot test to refine the attributes and levels to our patient population and discern any interpretation problems with the scenarios. Patients were very receptive to the format of the DCE.

This study has some limitations. We recognise there is an array of other factors that may impact a patient's willingness to perform postoperative therapy. Each participant enrolled in the study was at slightly different stages of his or her recovery process, but all the study participants had suffered a recent upper extremity fracture. Residual pain may not have been adequately described as it could be difficult for a patient to comprehend what mild, moderate and severe pain could be without specific examples. A tangible functional outcome was not used as one of the attributes for our choice sets. Activities of daily living was removed during our pilot study, but respondents might not be able to equate loss of range of motion with functional activities. Finally, the two scenarios in this question format force the participants to pick one therapy scenario when in reality they might not have chosen either. An opt-out option was not included because evidence recommends therapy after upper extremity fractures.

CONCLUSION

Patients with upper extremity fracture consider out-of-pocket costs vital when choosing a therapy programme. Clinically, improvements in range of motion demonstrated greater importance than residual pain, duration of therapy sessions and the location of therapy. These findings provide insight into understanding patients' preferences that may enhance informed patient-centred decisions and strategies in postoperative therapy regimens.

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