Journal of Hand Surgery Global Online xxx (2022) 1–6

Contents lists available at ScienceDirect

Journal of Hand Surgery Global Online

journal homepage: www.JHSGO.org

Review

Bringing Patient-Reported Outcome Measures (PROMs) Into Practice: A Review of the Latest Developments in PROM Use in the Evaluation and Treatment of Carpal Tunnel Syndrome

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ARTICLE INFO

Article history:
Received for publication January 8, 2022
Accepted in revised form June 19, 2022
Available online xxx

Key words:
Carpal tunnel syndrome
Patient-reported outcome measures
Value-based health care

As health care systems globally shift toward optimizing value, defined as health outcomes achieved per dollar spent across a full cycle of care, there has been increasing focus on using patient-reported outcome measures (PROMs) to gauge success. Patient-reported outcome measures are validated questionnaires that allow patients to share their health status across several domains (eg, pain or physical function). This trend has been particularly notable in hand surgery, with PROM use investigated for many common hand conditions, including carpal tunnel syndrome, Dupuytren contracture, trigger finger, osteoarthritis, and wrist ganglion. The purpose of this article is to review recent developments in the use of PROM instruments, including the Boston Carpal Tunnel Questionnaire; Michigan Hand Outcomes Questionnaire; Disabilities of the Arm, Shoulder, and Hand; and Patient-Reported Outcomes Measurement Information System, for the evaluation and treatment of patients with carpal tunnel syndrome. The considerable progress in establishing PROMs for use in carpal tunnel syndrome is reviewed, and future improvements are proposed to standardize PROM use and bring PROMs into day-to-day clinical practice for individualized patient treatment decision-making and counseling.

In a health care system that is beginning to recognize and incentivize value, defined as health outcomes achieved per dollar spent across a full cycle of care, it is becoming increasingly apparent that patient-reported outcome measures (PROMs) will play a key role in demonstrating value.[1–3] The Centers for Medicare and Medicaid Services (CMS) define patient-reported outcomes as the status of a patient's health condition or health behavior that is provided directly from the patient and measured using PROM instruments.[4] These outcomes, including health-related quality of life, functionality, and symptom burden, are a high priority for both CMS and patient-centric health care systems, as they provide patient-specific insight into disease progression and treatment efficacy.[4,5] Already requiring PROM collection for some orthopedic interventions, such as total joint replacement, CMS is also considering PROM-based performance measurement, highlighting the emphasis the organization places on PROMs as an indicator of value delivered.[6,7] Patient-reported outcome measures are also being used in orthopedics to calculate incremental cost-effectiveness ratios, which quantify the direct medical costs of an extra quality-adjusted life year of a procedure using real-world data, an improvement over previous, hypothetical models.[8] In addition to capturing insight on the value provided at a systems level, PROMs can also help individual surgeons make personalized treatment

Given her role as Editor in Chief, T.D.R. had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Eric Wagner, MD. No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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https://doi.org/10.1016/j.jhsg.2022.06.005

decisions for their patients, demonstrate expected recovery curves to help manage expectations, and monitor their aggregate patient outcomes compared with best-practice benchmarks.[7] Although clinical outcomes (eg, surgical complications) remain a central element of outcomes measurement and progress tracking, here, we consider PROM use in hand surgery, with a specific focus on use in the evaluation and management of carpal tunnel syndrome (CTS).

Historical Perspective

An early adopter of PROMs, the field of hand surgery has used many different PROM instruments in the last 3 decades. Common PROM instruments used for CTS include the disease-specific Boston Carpal Tunnel Questionnaire (BCTQ) and the region-specific Michigan Hand Outcomes Questionnaire (MHQ); Disabilities of Arm, Shoulder, and Hand (DASH); *Quick*DASH; and Patient-Rated Wrist Evaluation (Appendix 1, available on the *Journal*'s website at www.jhsgo.org).[9–13] The BCTQ is a 19-item instrument divided into functional status and symptom severity subscales.[9] The MHQ is a 37-item instrument divided into function, activities of daily living, work, pain, aesthetics, and satisfaction subscales.[10] The DASH is a 30-item instrument divided into activities of daily living, social activities, work activities, symptoms, sleeping, and confidence subscales, and also has an 11-item abridged version called the *Quick*DASH.[11,12] The Patient-Rated Wrist Evaluation is a 15-item instrument divided into pain and function subscales.[13] There is no alignment on PROM instrument choices for CTS. Surgeons must consider balancing the disease specificity offered by the BCTQ with the more robust assessments of daily living, sleep, and quality of life, which CTS patients describe as part of a successful outcome, offered by MHQ and DASH.[14] Additionally, the PROM instrument length is an important consideration, as survey fatigue is reported as a common obstacle to PROM implementation.[15] Although there is no absolute cutoff for an acceptable survey length, patients are estimated to be able to complete about 3 survey items per minute, with longer surveys introducing the possibility of errors and missing data.[16,17]

A systematic review looking at the use of PROMs in electively managed hand conditions across 834 studies from 1992 to 2017 found 9 disease-specific, 8 site-specific, and 4 quality-of-life measures used.[18] In terms of frequency of use, the review found that the DASH was the most commonly used measure, at an overall frequency of 41%, and the BCTQ was the most common disease-specific measure, used at an overall frequency of 23%.[18] Specifically looking at outcome metrics in the treatment of CTS in 105 studies from 2008 to 2018, another systematic review found that 94% of studies used PROMs, with the BCTQ used in 60% of studies and the visual analog scale for pain used in 51% of studies.[14] Although this historical commitment to PROM use in hand surgery and CTS is encouraging, the lack of standardization may impact the utility of the data. If PROM instrument use varies at the level of health care systems, clinical sites, or even individual surgeons, data cannot be effectively aggregated to compare treatment options and guide decision-making for patients with CTS. Furthermore, the use of disease-specific measures limits the generalizability of PROM data across a variety of hand conditions and may contribute to survey fatigue.[15]

An additional obstacle to using PROM data for the evaluation and treatment of CTS is alignment and agreement on what constitutes a minimum clinically importance difference (MCID) value, or "the smallest difference in score in the domain of interest which patients perceive as beneficial."[19,20] Although the MCID is an extremely important measure, as it provides an indication of whether a change in a PROM score is clinically meaningful, it is often not reported. One systematic review found that of 1,709 upper extremity–focused articles using PROMs published from 2014 to 2016, only 7.5% of them referenced an MCID.[20] Studies have investigated MCID values for PROMs commonly used in CTS, with proposed MCID values of 0.46 and 0.28 points for the BCTQ symptom severity and functional status subscales, respectively; 23, 13, and 8 points for the MHQ pain, function, and work subscales, respectively; 10.83 points for the DASH; 15.91 points for the *Quick*DASH; and 24 points for the Patient-Rated Wrist Evaluation.[21–24] However, the variation in MCID calculation methods and extensive variation in use of PROM instruments impacts the interpretation of these values and their utility in routine clinical practice at present.[20] For example, the MCID can vary for an instrument based on the patient population, the method of calculation, and the specific anchor question used and, thus, it is generally better to think of the MCID as a range rather than an absolute number (Table 1).[25–27]

Table 1
MCID Ranges for PROMs Commonly Used in Hand Surgery

PROM	MCID*
BCTQ[21]	0.46 (symptom severity) 0.28 (functional status)
MHQ[25]	8–13
DASH[26]	5–15
*Quick*DASH[26]	9–20
PRWE[24]	17–24
PROMIS[27,†]	3.0–4.1 (upper extremity) 2.1–4.1 (physical function)

PRWE, Patient-Rated Wrist Evaluation.
*Provided as a range for disease-agnostic PROM instruments.
†As noted in text, substantial MCID variation exists because of calculation methods, patient populations, and, for PROMIS, the form version used.

It is important to note that a recent study found that the BCTQ, the most commonly used PROM in CTS management, is not psychometrically valid when used as a single score generated across the symptom severity and functional status subscales.[28] That, along with the inability to standardize PROM use across hand surgery with a disease-specific measure, suggests that a shift away from using the BCTQ as the preferred measure for CTS management may be warranted.

Recent Developments in PROMs for CTS

In an attempt to address some of the limitations presented by existing PROMs, including issues with validity, survey fatigue, and generalizability of the instruments, the National Institutes of Health developed and validated a PROM platform known as the Patient-Reported Outcomes Measurement Information System (PROMIS).[29,30] The PROMIS, based on the biopsychosocial model of health, was created for general applicability across all conditions, enabling the use of a single tool to assess a patient's health status.[29] The PROMIS measures generate T-scores with a mean of 50 and standard deviation of 10 in the reference population, supporting ease of use.[31] The PROMIS is available in the following 2 options: (1) a static short form (ie, using the same questions each time for each patient); and (2) a computer adaptive test (CAT) that uses an algorithm to display questions based on previous responses, minimizing the total number of questions administered.[30] In the evaluation and treatment of CTS, the PROMIS physical function (PF), upper extremity (UE), and pain interference (PI) domains are used most often, with the domains for depression, anxiety, sleep disturbance, and ability to participate in social roles and activities also used (Appendix 2, available on the *Journal*'s website at www.jhsgo.org).[32–36]

Recent studies have demonstrated that the PROMIS correlates with previously validated PROMs for hand conditions, including the *Quick*DASH and the Brief Michigan Hand Questionnaire.[34,35] One carpal tunnel release (CTR)–specific study showed that the PROMIS PF, UE, and PI domains correlate with the MHQ and BCTQ, with stronger correlations for the PROMIS UE and PI domains.[32] The PROMIS UE and PI domains also demonstrated acceptable responsiveness when compared with the MHQ and BCTQ.[32] For CTS, 1 study showed excellent correlation between the PROMIS UE domain and the *Quick*DASH and good correlation between the PROMIS UE domain and the BCTQ.[33] The authors also found that the PROMIS UE domain required a shorter amount of time to complete and fewer questions compared to the other PROMs.[33]

In addition to demonstrating that the PROMIS PF, UE, and PI domains correlate with previously validated PROM instruments used for CTS, recent work has also proposed MCID values for PROMIS use in progress tracking for CTR. One study proposed a range of values for MCIDs in CTR based on the MHQ, the BCTQ, and a distribution-based method.[37] Another study looking at the PROMIS UE, PF, and PI domains in CTR reported MCID values of 3.6, 4.6, and −3.4 points, respectively, using a 1/2 standard deviation method.[38] While there is no standardized method of calculating an MCID, the 1/2 standard deviation method has been shown to apply in most clinical circumstances, suggesting these values may be a reliable starting point.[38,39] However, as MCID calculations can vary based on the method used, with most common calculation approaches including anchoring to a subjective scale and using a statistical distribution-based approach, it is important to consider MCID values within a range (Table 1).[39] For PROM-based treatment efficacy tracking in populations, an estimated MCID range is likely sufficient. For treatment efficacy determinations in individual patients, the MCID range can be interpreted within the clinical context. This recent work on MCID values supports the implementation of the PROMIS in CTS and use of the PROM to track outcomes improvement, but should be used with caution when determining the “success” or “failure” of a procedure based on reaching or not reaching the MCID. The counterpoint is that MCID values may be better when looking at populations or groups or when powering research studies.

In addition to supporting functional status and pain impact tracking, the PROMIS also includes other domains, such as for depression, anxiety, sleep disturbance, and the ability to participate in social roles and activities, which enable global assessments of patient outcomes. One study looking at patient recovery from hand surgery, including CTR, demonstrated that higher postoperative PROMIS PF scores were independently associated with lower PROMIS PI and depression scores.[40] Another study demonstrated that irrespective of the treatment choice to manage nontraumatic upper-extremity conditions, including CTS, higher PROMIS depression scores were associated with increases in the number of office visits.[41] These studies highlight the importance of a global assessment of patient outcomes, including a focus on monitoring mood, which is enabled by a general PROM, such as the PROMIS.

Although the PROMIS has demonstrated substantial utility in the evaluation and treatment of CTS, it has some limitations as well. One study suggested that the PROMIS is unable to detect immediate patient improvement within the first 3 weeks after CTR.[42] This limitation would need to be taken into account when determining the timing for administering the PROMIS during patient follow-up visits. Additionally, while the PROMIS questionnaires are less time intensive than many other PROMs used for CTS, a study showed that the Single Assessment Numeric Evaluation, consisting of only 1 question, has a moderate to strong correlation with the *Quick*DASH and PROMIS UE domain.[43] Although we do not believe that survey fatigue is a critical enough concern to warrant the use of a single-question PROM for the general population, it may be a better choice for select groups that have difficulty with longer surveys or electronic PROM capture tools, and may also enhance patient comprehension compared to other PROM instruments.

As the PROMIS is not as specific to CTS as the BCTQ or as specific to the hand as the MHQ or DASH, the BCTQ may be better for research purposes. In clinical use, however, the PROMIS is preferable and sufficient for assessing CTS as part of routine care. Although the PROMIS has been demonstrated to have comparable utility to disease-specific measures for CTS, it is possible that it may not detect outcomes improvements as well as disease-specific measures for other hand conditions. However, with clinical judgment, we believe this potential drawback can be mitigated while still allowing for the benefits of using a generalized measure to be realized. To enable a global assessment of patient outcomes, combat survey fatigue, streamline implementation of PROMs, and support standardization to increase the utility of PROM data collection, it is important to consider a tool such as the PROMIS. As a single tool, the PROMIS has the potential to replace disease- and region-specific PROM instruments in the care of patients with CTS. Not only would this be acceptable for this specific population, but using PROMIS instruments across conditions within hand surgery and across different specialties would also enable standardization and simplification of the PROM collection process.

To the Clinic! Implementation of PROMs to Support Shared Medical Decision-Making in Carpal Tunnel Syndrome

To date, PROM data have largely been collected and used in academic and research settings.[4,44] However, there is a great deal of untapped potential to use PROMs in day-to-day clinical practice. As PROM data for CTS are collected and analyzed, they can inform more personalized treatment decisions for patients. The beginnings of this process are already underway. One study looking at treatment choices for patients with nontraumatic upper-extremity conditions, including CTS, showed that higher PROMIS PI scores were associated with elective surgery, suggesting that patients with a greater tendency to limit activity based on pain are more likely to undergo surgery.[45] A Canadian clinical trial is assessing the use of PROM-based decision aids for patients and surgeons to help determine the appropriateness of a total knee arthroplasty.[46] One can imagine that something similar would be of great value in the evaluation and treatment of CTS. These insights based on PROMIS scores can help surgeons counsel their patients about treatment options and jointly select options that would provide the greatest benefits to individual patients.

Patient-reported outcome measure data can also help surgeons counsel patients on their expected recovery timeline and set expectations regarding the level of improvement from a treatment choice. One study looking at typical recovery in the PROMIS PF and PI domains after a total knee arthroplasty found that the majority of improvement occurred within 3 months, with 90% of improvement occurring within 6 months.[47] This insight provided by PROMIS score-based typical recovery curves can support improvement of patient education and expectation management after surgery.

In addition to equipping surgeons to have data-driven conversations with patients, PROM use has also been shown to increase patient satisfaction with the surgeon encounter. A survey of University of Pittsburgh Medical Center orthopedic patients demonstrated that patients who had their PROMs scores discussed with them rated their physician more highly for communication and shared decision-making.[48] As PROM data collection and use become more routine and are incorporated in real time into the clinical setting, they can quickly give the surgeon a picture of a patient’s health, support shared decision-making by enabling the

Table 2
The Hospital for Special Surgery's Guiding Principles for PROM Collection and Use

Guiding Principles
1. Patients are asked the right questions at the right time, without redundancy or duplication.
2. Patients have a clear understanding of what information they are being asked to provideand why.
3. Data collected are available to all clinicians who care for the patient at the point of care.
4. Data collected across the enterprise are stored consistently in a central warehouse.

surgeon to have a data-driven discussion with the patient about the likelihood of treatment efficacy based on their scores, and help the system move toward measuring performance based on outcomes that matter.[44]

Furthermore, at a systems level, PROM data can be used for cost-utility analyses for specific procedures for specific patient populations. A recent Swiss study demonstrated the utility of arthroscopic rotator cuff repair compared to nonsurgical management using quality-of-life and shoulder-function PROMs. This study calculated an incremental cost-effectiveness ratio of 24,924 CHF per quality-adjusted life year, much lower than the typically accepted cost-effectiveness cutoff off 100,000 CHF per quality-adjusted life year. As CMS shows an increasing propensity for value, this type of PROM-based cost-utility analysis may play a larger role in clinical guidelines.

In order to use PROM data to their fullest extent, data must be comprehensive, standardized, and available in real time. Many surgical practices have identified obstacles in achieving these goals, with 1 review of PROM implementation highlighting patient-reported barriers, including survey fatigue, a lack of interest in completing PROMs, and the unclear purpose of PROMs, and staff-reported barriers, including the time burden and insufficient information regarding utility.[15] The PROMIS CAT has demonstrated ability to overcome these barriers, with multiple surgical practices reporting ease of use and real-time data availability. One study reported integrating PROMIS CATs into the workflow of orthopedic outpatient clinics using iPad-based data collection, with CATs scored in real time and displayed visually for clinician use.[31] This study reported that CATs were completed in less than 5 minutes, with >90% of patients willing to complete an assessment again. Another private orthopedic practice that had a similar approach to implementation, using tablets to administer CATs with data available in the electronic medical record, found that most patients completed the CATs in under 3 minutes in the examination room while waiting for the clinician.[49] This study also demonstrated that the PROMIS can be implemented with estimated costs of $350 per tablet, $1,800 per year for server costs, and $5,000 per year for PROMIS application programming interface costs.[49] The Hospital for Special Surgery has defined the following 4 guiding principles for PROM collection and use: (1) patients are asked the right questions; (2) patients have a clear understanding of what information they are being asked to provide; (3) data collected are available to all clinicians; and (4) data are stored consistently and centrally (Table 2).[2]

Hand surgery has made progress in routine PROM collection and use, with future work to be directed toward standardization of measures and implementation into the clinical workflow to support shared medical decision-making. With that in mind, we highlight the following hypothetical CTS patient encounter, representing an ideal use of PROMs in clinical practice in the near future.

Mr Smith presents to a hand clinic after being referred by his primary care physician for suspected CTS. Upon checking in for the appointment, Mr Smith uses a tablet computer to fill out the PROMIS PF, UE, PI, and depression CATs. While waiting to be roomed, in less than 5 minutes, Mr Smith completes the CATs, which are scored in real time and uploaded into his electronic medical record.[31,49] Mr Smith's surgeon reviews his PROMIS scores before entering the room and sees that Mr Smith has a high PROMIS PI score, suggesting that pain hinders many of his activities; thus, based on data on patients like him, he may be interested in surgical intervention.[45] His surgeon additionally notes that his PROMIS depression score is high. All of this insight is gathered by the surgeon prior to her even entering the clinic room to begin the encounter, allowing for a more focused and patient-centered start to the visit. Once the surgeon enters the clinic room, she gathers a clinical history and performs a physical examination. They discuss Mr Smith's condition (ie, CTS) and the treatment options. Mr Smith is told that patients with similar PROMIS scores generally show substantial symptom improvement after surgery.[2,45,50,51] Mr Smith and his surgeon discuss the risks and benefits of CTR and jointly decide that Mr Smith will undergo the surgery. Knowing that his PROMIS depression score is high, Mr Smith's surgeon inquires about his mood and learns that his spouse recently passed away. Aware that depression can impact postsurgical recovery and early outcomes, Mr Smith and his surgeon jointly decide that his surgery will be delayed to allow Mr Smith adequate time to grieve.[41] Mr Smith's surgeon flags his high PROMIS depression scores to his primary care provider in the electronic medical record to ensure that his depressive symptoms are addressed appropriately. Three months later, Mr Smith undergoes CTR surgery, with his preoperative PROMIS scores showing improvement in his depressive symptoms. Eight weeks after his surgery, Mr Smith presents to the clinic for follow-up. He fills out the PROMIS PF, UE, PI, and depression CATs while waiting to see his surgeon. Before seeing Mr Smith, his surgeon reviews his PROMIS scores, which show >50% of expected improvement, with PROMIS PF and PI scores that are in line with expectations based on the typical recovery curve. Mr Smith's clinical evaluation confirms this finding.

Conclusion

There are many barriers to implementing PROMs for use in the real-time evaluation and treatment of patients with CTS, including technology requirements, costs, time burden, and staff education; however, there is notable unrealized potential for using PROMs in clinical practice in hand surgery to guide shared decision-making, enable surgeons to personalize treatment decisions, and have data-backed conversations on expectation setting.[2,15,50] Many orthopedic practices have begun to overcome PROM use obstacles with the incorporation of real-time PROM collection into their clinical workflow.[31,49] Within hand surgery specifically, in order to realize the clinical utility of PROMs, process guidelines on using PROMs in real-time clinical care need to be developed.[52] With the establishment of guidelines and standardization of PROM use, the field will be able to use PROMs to support day-to-day care of patients with CTS. As a tool that is generalizable, easy to use, quick, and available in real time, the PROMIS is a great option for PROM standardization in patients with CTS and should be collected as close to the day of intervention as feasible as a pretreatment baseline and within 90 days after intervention.[37,38,53]

As more PROM data are collected, aggregated, and analyzed, hand surgeons will be able to provide CTS patients with specific guidance on which treatment options have the highest likelihood of

success for patients like them. They will also be able to better educate patients on their recovery timeline and expected improvement from treatments. With PROM use, patients will also have higher satisfaction with their surgeon encounters. At an individual-provider level, surgeons will be able to benchmark their patient outcomes to best-practice standards. On a macroscale, as the health care system shifts toward value, with an initial focus on elective procedures, hand surgeons will be able to demonstrate the notable cost utility and impact their care has on patients with CTS.

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