

DESCRIPTIVE REPORT

Between-session changes predict overall perception of improvement but not functional improvement in patients with shoulder impingement syndrome seen for physical therapy: An observational study

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ABSTRACT

Do between-session changes in global rating of change (GRoC) predict change in GRoC and self-report of function at discharge in patients with shoulder impingement that initially improve in early sessions of treatment (GRoC>5)? Is there a difference between individuals who initially respond to treatment (GRoC>5) compared to those that do not (GRoC<5) for self-report of function? This longitudinal, observational study had 55 patients seen for a formal physical therapy program after a medical diagnosis of shoulder impingement. Physical therapy used a standardized protocol. The American Shoulder and Elbow Surgeons Subjective Shoulder Scale (ASES) and self-report of improvement of condition using the GRoC were measured. We found no significant correlation between the first visits between-sessions changes of the GRoC and the change score of the ASES ($r=0.13$; $p=0.39$) in patients with shoulder impingement that initially improve in early sessions of treatment (GRoC>5). There was a moderate correlation between the first visits between-session changes of the GRoC and the final reported GRoC ($r=0.48$; $p<0.01$) for the patients who responded to treatment. There was no difference in ASES change scores between those who initially respond to treatment ($N=10$) and those who do not ($N=34$). ASES mean change scores were 21.5 for the responders and 14.3 for the non-responders. These findings suggest that a GRoC of 5 or greater is related to a perceived change in one's condition upon termination of formal physical therapy but is not related to actual improvement in one's self-report of function. This finding suggests that the construct of the GRoC may not be related to the constructs of the ASES, or between-session changes are not prognostic in patients with shoulder impingement and should not solely dictate treatment decision making.

INTRODUCTION

Shoulder impingement syndrome involves compression of the rotator cuff and subacromial bursa against the anterolateral aspect of the acromion (Buss, Freehill, and Marra, 2009). Etiology involves external

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(also known as extrinsic) and internal factors, which include elements such as a tight posterior capsule, morphological changes of the acromion, weakness in the rotator cuff, inflammation associated with trauma, and degenerative changes in the acromioclavicular joint (Mulyadi, Harish, O'Neill, and Rebello, 2009). Impingement syndrome is a clinical diagnosis that is routinely supported by imaging findings (Buss, Freehill, and Marra, 2009). Germane to the syndrome are motion loss, strength loss, and shoulder pain that worsens at night and with overhead activity (Lin, Weintraub, and Aragaki, 2008). Patients with shoulder impingement syndrome are routinely conservatively treated by physical therapists using techniques such as manual therapy, strengthening, and behavioral modification. In a recent systematic review of 11 randomized, controlled trials, physical therapy exercises were shown to be effective for decreasing pain and improving function in patients with rotator cuff impingement (Kuhn, 2009). The use of manual therapy in these studies augmented the exercise benefits. One study (Bang and Deyle, 2000) evaluated manual physical therapy in combination with exercise compared to exercise alone in patients with shoulder impingement. They found a significantly greater decrease in pain and increase in strength in the group who received manual therapy.

Physical therapists are often guided by assessment of immediate effects, both patient perceived and clinician observed (e.g., changes in range of motion, improvements in strength) that occur during examination or intervention, particularly in manual therapy methods. This assessment rationale has been advocated for the shoulder, spinal, and all other regions of the body (Edwards, Jones, and Hillier, 2006). Recently, a number of studies have explored techniques that are associated with immediate effects (also described as within-session effects) toward a positive recovery for the patient (Cleland et al, 2005; Dunning and Rushton, 2008; Hall, Hardt, Schafer, and Wallin, 2006; Konstantinou et al, 2007; Paungmali, O'Leary, Souvlis, and Vicenzino, 2003; Paungmali, Vicenzino, and Smith, 2003; Teys, Bisset, and Vicenzino, 2008). The studies examined changes in variants of pain, motion, and strength attributed to neurophysiological effects.

Although within-session changes have been studied and documented, less frequently investigated is the carryover of immediate effects to the next treatment visit; a concept known as a between-session change. Between-session changes are a notable element of clinical decision-making models and are advocated as a stronger guide of treatment selection and application (Edwards, Jones, and Hillier, 2006). Immediate effects have been shown to predict between-session changes at

the lumbar (Hahne, Keating, and Wilson, 2004) and cervical spine (Tuttle, Laakso, and Barrett, 2006), although a significant drop in neurophysiological effects usually occur during long-term follow-up (Axen et al, 2002; Thiel and Bolton, 2008). In the shoulder, between-session changes have been used subjectively via patient response to determine treatment progression (Bang and Deyle, 2000).

Tuttle, Laakso, and Barrett (2006) investigated the relationship of between-session changes of impairments with self-report of function and patient-perceived perception of change in patients with neck pain greater than 2 weeks with noticeable mobility restrictions. Their findings showed that between-session changes of impairments were predictive for improvement in impairments but not for improvement in function by termination of the treatment program. Furthermore, between-session changes of patient perception of change were also associated with patient perception at the end of treatment, although there was no association with between-session, patient perception of change, and disability/ functional scores at end of treatment.

These findings suggest that between-session changes in both impairments and perception of change may not be predictive for change in function by end of treatment in patients with neck pain and mobility restrictions. If this finding is transferable to other musculoskeletal conditions in the body, then clinicians who routinely use the assessment findings associated with between-session changes may formulate a treatment progression that fails to capture functional improvements. Consequently, the purpose of this study was twofold: 1) to determine if a between-session change (5 points or greater) reported on the Global Rating of Change scale (GRoC) (within the first sessions of formal physical therapy) was prognostic for final improvement in the GRoC and for functional improvement as measured by the ASES at discharge in patients with shoulder impingement who initially improve in early sessions of treatment (GRoC > 5) and 2) to determine if there is a difference for functional improvement as measured by the ASES at discharge between individuals who initially respond to treatment within the first sessions of formal physical therapy (GRoC > 5) compared to those who do not (GRoC < 5).

METHOD

Design

The study was a prospective, longitudinal, observational study in which measurements were captured weekly over a span of a treatment program for

conservative care of patients with a diagnosis of shoulder impingement. On average, treatment was initiated within 2 days of receiving a steroid/lidocaine subacromial injection from the physician. Treatment was terminated when the patient and/or therapist determined that the patient had met their maximal recovery with the conservative process. This process included analysis of improvements in outcome measures, range of motion, strength, and overall discussion of patients' self-perceived level of improvement with their shoulder. Nonoperative treatment consisted of the synthesized parameters outlined in a recent systematic review (Kuhn, 2009). The approach consisted of three stepwise phases in which progression occurred only if pain was reported as 2 points or less on a visual analog scale of pain from 1 to 10. The three phases included 1) the inflammatory phase, 2) the subacute/early strengthening phase, and 3) advanced strengthening. The clinical and home treatment programs were standardized for all subjects in each phase regardless of presentation; however, the dosage of the interventions was specific to the examination findings for each patient and managed by the treating therapist. Thus, the use of manual therapy, modalities, and exercise, although standardized for selection, was specific to the needs and response of each patient. The treatment methods are outlined in Table 1 and primarily included manual therapy, self and externally applied stretching, isotonic strengthening, and restoration of normative movement. The Institutional Review Board of Greenville Hospital System, Greenville, South Carolina, approved research procedures.

Participants

A total of 55 consecutive patients (31 males and 24 females) with an average age of 52 were identified during regularly scheduled visits to participating physicians and/or physical therapists. They were considered for study participation if they were medically diagnosed with impingement syndrome. The logistics of the referral process from the physicians did not allow for a control group; thus, patients were enrolled and received a standard course of physical therapy. All patients exhibited one or more of the following clinical findings: dull ache at the anterolateral aspect of the shoulder (often with radiation to the deltoid insertion); complaints of pain with overhead activity; pain with resisted abduction and external rotation; and pain with overhead positioning of the arm or direct pressure against the shoulder such as lying on it. Physical findings included positive Hawkins-Kennedy impingement test; pain along the bicipital groove with resisted forward flexion and extended elbow with forearm supination; a painful

arc of abduction between 60 and 120 degrees, which increased with resistance at 90 degrees; range of motion restrictions; and tenderness with palpation over the greater tuberosity at the supraspinatus insertion and along the anterior edge of the acromion. Patients were excluded from the study by the research coordinator (who was blinded to the measurements) if they experienced signs and symptoms associated with cervical radiculopathy; thoracic outlet syndrome; brachial plexus dysfunction; neoplasms; adhesive capsulitis; calcific tendonitis; or glenohumeral arthritis. A total of 44 individuals were included and completed the study.

The patients were separated into two groups for statistical analysis based on whether they improved by >5 points on the GROC within the first sessions of formal physical therapy. A score of 5 or greater has been identified as an important improvement (Stratford et al, 1994). Patients scoring >5 on the GROC are described in this study as Responders ($N=10$), whereas those scoring <5 on the GROC are described as Non-Responders ($N=34$).

Outcome measures

Outcome measures included the American Shoulder and Elbow Surgeons Subjective Shoulder Scale (ASES) and self-report of improvement of condition using the global rating of change scale (GROC). The ASES was developed by the Research Committee of the American Shoulder and Elbow Surgeons and was adopted by the membership as a standardized form for measurement of musculoskeletal function (Cook et al, 2008). The questionnaire, which includes two theoretical subscales, pain and function/disability (McClure and Michener, 2003), has been shown to possess reliability (Kocher et al, 2005, McClure and Michener, 2003), construct validity with the SF-36 (McClure and Michener, 2003; Michener, McClure, and Sennett, 2002) and responsiveness when moderate to large effect sizes are present during treatment (McClure and Michener, 2003). In addition, a minimally clinically important difference (MCID) has been demonstrated as a change of 6.4 ASES points (Michener, McClure, and Sennett, 2002).

The GROC is a single-item, recall-based questionnaire of well-being since an initial treatment encounter. Patients were asked to make global ratings on changes in regards to their level of shoulder well-being since the previous week's treatment on a 15-point self-report scale (from -7 to 7) (Figure 1). The GROC has demonstrated useful anchor properties when used in the short term but does suffer from recall bias when used in long-term analyses (Norman, Stratford, and Regehr, 1997; Schmitt and Di Fabio, 2004; Schmitt and Di Fabio, 2005). Likewise, a GROC score of 5 or greater has been identified as an

TABLE 1 Shoulder impingement treatment protocol

Patients may progress in exercise and to new phases only if the progression does not increase pain by more than 2 points on a Visual Analog Pain Scale.

Phase 1 Inflammatory phase	Focus	Home program	Clinic treatment
	<ul style="list-style-type: none"> * Decrease inflammation/pain * Improve glenohumeral ROM * Improve scapulothoracic ROM * Improve scapular neuromuscular control 	<ul style="list-style-type: none"> * AAROM – 40 – 50 repetitions <ul style="list-style-type: none"> - supine ER, flexion - standing IR behind back - scapular retraction * Submaximal Isometrics – 3 sets of 10 reps <ul style="list-style-type: none"> - Flexion, Extension, IR, ER 	<ul style="list-style-type: none"> * Soft tissue mobilizations * Joint mobilizations <ul style="list-style-type: none"> - Grades I–II for pain relief - Grade IV–2 sets of 20–30 repetitions (superior-inferior, anterior-posterior) * AAROM <ul style="list-style-type: none"> - 40–50 repetitions - supine ER, Flex, Ext, ER - standing IR behind back - doorway ER stretch - Manual ROM - Flex, ER, IR - Rhythmic stabilization – 3 sets of 30 seconds - Submaximal Isometrics - Modalities as needed - Posture modification * Progression standard – 80% full AROM against gravity, worst pain 5/10 or less during normal ADLs
Phase 2 Subacute phase: Early strengthening	Focus	Home program	Clinic treatment
	<ul style="list-style-type: none"> * Continue with modalities, ROM, and scapular NM re-education as needed per Phase I * Begin isotonic strengthening 	<ul style="list-style-type: none"> * Terminal stretch – 30 second hold with 5 reps <ul style="list-style-type: none"> - doorway pectoralis minor stretch - sleeper stretch IR - cross body stretch - door hang * Isotonic strengthening – no weight 3 sets to fatigue (or 30 reps). Progress to 3×30 reps with no weight, add maximum of 1# per session advancing per above criteria <ul style="list-style-type: none"> - sidelying ER - supine punch - supine flexion 	<ul style="list-style-type: none"> * Sport cord strengthening – 3 sets to fatigue (or 30 reps). If able to complete 3×30 reps with red cord, add one level of cord per session advancing per above criteria. Cue scapula as needed. <ul style="list-style-type: none"> - IR with ABD pillow - ER with ABD pillow - long arm extension - supine punch * Rhythmic Stabilization – 3×30 seconds * Manual/terminal stretching * Progression standard: Isotonics – 3 sets of 30 repetitions with 2# <ul style="list-style-type: none"> - sidelying ER - supine flexion - prone T's (one arm, thumb up) Rhythmic stabilization <ul style="list-style-type: none"> - 1 minute hold at standing gunslinger (0 degrees IR/ER) - no increase in pain - proper form - maintain scapular retraction
Phase 3 Advanced strengthening	Focus	Home program	Clinic treatment
	<ul style="list-style-type: none"> * Progress rotator cuff and scapular strengthening 	<ul style="list-style-type: none"> * Terminal stretch – 30 second hold for 5 reps 	<ul style="list-style-type: none"> * 10 minute warm-up on UBE – medium resistance (level 3 to 6)

(Continued)

TABLE 1 Shoulder impingement treatment protocol

Patients may progress in exercise and to new phases only if the progression does not increase pain by more than 2 points on a Visual Analog Pain Scale.

Phase 3 Advanced strengthening	Focus	Home program	Clinic treatment
	* Return patient to normal function with ADLs and recreational activities	<ul style="list-style-type: none"> - doorway pectoralis minor stretch - sleeper stretch IR - cross body stretch - door hang stretch * Isotonic strengthening – no weight 3 sets to fatigue or 30 repetitions. If able to complete 3×30 repetitions with no weight, add maximum of 1# per session advancing per above criteria <ul style="list-style-type: none"> - sidelying ER - prone I's (thumbs up) - prone T's (thumbs up) - standing scaption to 90 degrees 	* Sport cord strengthening – 3 sets to fatigue or 30 repetitions. If able to complete 3×30 repetitions with red cord, add one level of cord per session advancing per above criteria. <ul style="list-style-type: none"> - IR/ER at 90/90 - Reverse flies (scapular retraction) - Bear hug (punches) * Rhythmic stabilization – 5 × 30 seconds <ul style="list-style-type: none"> - standing 90/90 (scapular plane) - wall plank flexion (leaning forward with hands on wall) – 3 sets to fatigue or maximum of 30 repetitions/set - ball circles on wall – 3 sets to fatigue or maximum of 30 repetitions per set - Manual – PNF patterns – 3 sets to fatigue or maximum of 30 repetitions per set * Discharge criteria – full and pain-free AROM <ul style="list-style-type: none"> - pain-free return to ADLs - achievement of acceptable functional outcome measures

ER: external rotation; IR: internal rotation; ROM: range of motion; AAROM: active assistive range of motion; PNF: proprioceptive neuromuscular facilitation; ADL: activities of daily Living.

important improvement that reflects the continued pursuance of treatment (Stratford et al, 1994).

Data analysis

All analyses were calculated by using SPSS version 14.0 (Chicago, IL 60606). Descriptive analyses were captured to adequately describe the baseline characteristics of the 55 patients. Correlation analyses consisted of a biserial correlation of first visits between-session changes of the GRoC for Responders (5 point reported change) with the ASES change score (termination of care minus initial score). In addition, an unpaired t-test was used to evaluate ASES change scores between patients who met a 5 points or greater change in the GRoC (Responders) vs. those who failed to meet that value (Non-Responders).

RESULTS

The 55 patients included 31 males and 24 females. The majority of the patients were under the age of 65 (87.5%) and were able to work without restrictions (60.4%). Patients reported 1.5 (SD 1.5) prior episodes

of similar shoulder problems and identified baseline ASES scores of 53.4 (SD 19.8). Most conditions were chronic, with patients indicating an average of 240 days (SD 347) of symptoms.

We found no significant correlation in patients with shoulder impingement that initially improved in early sessions of treatment (GRoC>5) between-session changes of the GRoC and the change score of the ASES ($r=0.13$; $p=0.39$). There was a moderate correlation between the first visits between-session changes of the GRoC and the final reported GRoC ($r=0.48$; $p<0.01$).

The unpaired t-test demonstrated no significant differences for the ASES change scores between those who met the GRoC change of 5 or greater (Responders) vs. those who did not (Non-Responders) ($p=0.39$). The mean ASES change score for the Responders and the Non-Responders was (21.5 ± 25.9) and (14.3 ± 22.1) , respectively.

DISCUSSION

The purpose of this study was twofold: 1) to determine if a between-session change reported on the GRoC (within the first sessions of formal physical therapy) was

Overall, has there been any change in your shoulder since your last visit? Please indicate if there has been any change in your shoulder by choosing one of the following options:

- WORSE
- ABOUT THE SAME (Points = 0)
- BETTER

If you stated "Better", how much better are your symptoms? Are they:

	<u>Points</u>
Almost the same, hardly any better at all	1
A little better	2
Somewhat better	3
Moderately better	4
A good deal better	5
A great deal better	6
A very great deal better	7

If you stated "Worse", how much worse are your symptoms? Are they:

	<u>Points</u>
Almost the same, hardly any worse at all	- 1
A little worse	- 2
Somewhat worse	- 3
Moderately worse	- 4
A good deal worse	- 5
A great deal worse	- 6
A very great deal worse	- 7

FIGURE 1 The global rating of change scale.

prognostic for final improvement in the GRoC and for functional improvement as measured by the ASES at discharge in patients with shoulder impingement who initially improve in early sessions of treatment (GRoC > 5) and 2) to determine if there is a difference for functional improvement as measured by the ASES at discharge between individuals who initially respond within the first sessions of formal physical therapy (GRoC > 5) compared to those who do not (GRoC < 5).

A first week GRoC change of 5 or more was found to be related to a higher GRoC at discharge. Perception of change at the beginning of therapy has previously been shown to predict perception of change

by the end of treatment in a patient population with neck pain (Tuttle, Laakso, and Barrett, 2006). These findings in combination with our results of a moderate correlation of between-session changes in the early stages of physical therapy and the final visit suggest a prognostic value may be ascertained during the initial stages of treatment. As such, our study suggests the identification of early improvements of pain in patients with a diagnosis of shoulder impingement may help to guide the decision making of clinicians for progressing treatments. An improvement in the GRoC after the first week of therapy may lead the clinician to advance the patient's plan of care in a more aggressive manner

based on the early success and the potential for a positive outcome by the completion of a formal physical therapy program. This patient may progress with higher repetitions and/or greater resistance and subsequently work into functional activities at an earlier stage based on their GROC scores. On the other hand, if the patient did not experience improvement or if there was only moderate improvements, then he/she was progressed at a slower rate based on their reported findings.

While there was correlation between the initial and final GROC scores, no such correlation existed in first visits between-session changes of the GROC and the overall change score of the ASES. Similar results for activity level have been shown in patients with subacute neck pain (Tuttle, Laakso, and Barrett, 2006). In 29 patients receiving manual physical therapy for neck pain, changes in impairments (range of motion and pain) within the first two treatments did not predict change in activity by the end of treatment. As with our study, although patients initially reported an overall perception of improvement (Tuttle, Laakso, and Barrett, 2006), this perception did not necessarily translate to improvements in activity. These results suggest that the GROC and the ASES may in fact measure two wholly different constructs.

Use of the ASES as a measure of function in patients with shoulder pain has demonstrated reliability, validity, and responsiveness (Michener, McClure, and Sennett, 2002). The ASES is a two-dimensional instrument that captures the constructs of pain and function (Cook et al, 2008), whereas the GROC is considered a multidimensional assessment tool that can reflect a patient's perception of health status, disability, work ability, or quality of life. Global assessment tools such as the GROC allow a patient to internally define what they consider to be important, and for each patient these constructs may indeed differ. This may have contributed to our results of not finding a relationship between the GROC and ASES (Dworkin et al, 2005).

In contrast, of importance is that the sole use of the GROC may lead to a minimized long-term outcome involving function. Function, as captured by the ASES, is defined by a series of questions that relate to common activities of daily living that require range of motion, dexterity, and strength. Allowing patient interpretation of the concepts of the GROC may lead to an overemphasis on reduction of pain, particularly if the clinician addresses this construct in their day-to-day clinical decision-making model. The use of within- and between-session changes reinforces this concept of pain reduction and may be short-sighted during long-term treatment of selected musculoskeletal conditions.

Strengths and weaknesses

Previous literature has supported this model of between-session changes in predicting outcomes in the low back (Hahne, Keating, and Wilson, 2004) and neck (Tuttle, 2005; Tuttle, Laakso, and Barrett, 2006). However, to the best of our knowledge, this is the first study to examine between-session changes in patients with a diagnosis of shoulder impingement. The sum of these findings suggests that changes between treatment sessions does mean something and should be considered in the management of shoulder impingement patients. Nonetheless, our results should be interpreted with careful consideration and may not be extrapolated to the general population who has not followed a standardized treatment protocol (Table 1).

Our sample size of 55 patients proved sufficient to detect a significant correlation of the reported GROC between the first sessions and final GROC at the end of treatment. While this sample was larger than previously reported literature in the neck (Tuttle, Laakso, and Barrett, 2006), it was similar to data in the low back (Hahne, Keating, and Wilson, 2004).

Notably, all patients received a steroid/lidocaine subacromial injection prior to initiation of physical therapy. Although repeated use of injections (multiple injections over time) in patients with impingement has been associated with a positive long-term outcome at a 2-year follow-up (Cummins, Sasso, and Nicholson, 2009), the temporal nature of the effects of a single injection are less known (Skedros and Pitts, 2007). Maximal benefits of an injection for patients with subacromial impingement appears to occur at 30 minutes and are predictive for a short-term outcome only when cases demonstrate 75% elimination of symptoms after injection (Skedros and Pitts, 2007). Furthermore, the comparative effectiveness of injection vs. no injection has not been demonstrated in a number of randomized controlled trials (Buchbinder, Green, and Youd, 2003). In our study, we did not evaluate whether 75% resolution of symptoms occurred with injection; thus, we are unable to identify the relationship of injection toward our findings of between-session changes.

As a patient ages, the chance of developing a rotator cuff tear increases (Yamaguchi et al, 2006). The fact that over 87% of the patients in this study were under the age of 65 suggests age may have played a role in our findings. The patients enrolled in our study were not diagnosed with a rotator cuff tear and for the most part were able to function with their work requirements. Likewise, it appears that although the patients reported their conditions as chronic in nature, the average baseline ASES scores imply a moderate level of function with activities of daily living. The combination of these demographic findings may have contributed to the

patient's perception of improvement as assessed by the GRoC.

Another limitation within our study is the manner in which conservative treatment was terminated. As mentioned earlier, the process for determining when a patient had completed their course of physical therapy included analysis of improvements in outcome measures, range of motion, strength, and overall discussion of patient's self-perceived level of improvement with their shoulder. Within this framework, there is a potential for an introduction of bias into the decision-making process by either the therapist or the patient. However, efforts were made to control for bias. Treatment decision making was designed with evidence-based parameters from a recent meta-analysis (Kuhn, 2009), which allowed clinicians to remain as objective as possible. In addition, this study was clinical in nature and as such, was designed to replicate the normal patient-therapist interaction and decision-making process.

CONCLUSION

In summary, the findings suggest that a GRoC of 5 or greater is related to a perceived change in one's condition upon termination of formal physical therapy but is not related to actual improvement in one's self report of function. This finding suggests that the construct of the GRoC may not be related to the constructs of the ASES or between-session changes are not prognostic in patients with shoulder impingement and should not solely dictate treatment decision making.

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