Patient Outcomes Significantly Improve When Receiving Treatment by Athletic Therapy Students

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complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ABSTRACT

Patient Outcomes Significantly Improve When Receiving Treatment by Athletic Therapy Students

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Student-run clinics are beneficial and provide interactions between education and community. Treatment outcomes by students are rarely measured. To our knowledge, no studies evaluate student athletic therapist's rehabilitation outcomes. The purpose of our study was to measure the improvement in function in injured patients seeking treatment at the student-run Athletic Therapy PERFORM Clinic. **Main Outcomes and Measures: At baseline** and at follow-up, student-treated patients completed one of three questionnaires to assess their injured level of function: Oswestry Disability Index (ODI) for low back injuries, Lower Extremity Functional Scale (LEFS) for lower extremity injuries and Disabilities of the Arm Shoulder and Hand (DASH) for upper extremity injuries. **Results: On average,** patients received 4.7 ± 1.8 treatments across 48.8 ± 16.1 days. Overall, patients experienced a statistically significant increase in function between assessment and follow-up (18.8% ± 20.3, $p < 0.001$). Patients with an acute injury improved more compared to patients with a chronic pain injury ($p < 0.001$). While there was no significant difference in function at baseline between patients with acute injuries and chronic pain/injuries, there was a trend towards patients with an acute injury being less functional ($p = 0.051$). **Discussion:** Improvements in function in injured patients at this student-run clinic are similar to the minimal clinically important difference respective to each questionnaire. The clinic offers an additional benefit to patients with a robust cost-effectiveness ratio. Our results suggest that Athletic Therapy education should investigate the different needs of chronic injury patients in order to maximize improvements in function.

Key words: Disability, low back pain, LEFS, DASH, ODI

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AT Athletic training and athletic therapy

PT physical therapy and physiotherapy

ODI Oswestry Disability Index,

LEFS Lower Extremity Functional Scale,

DASH Disabilities of the Arm, Hand and Shoulder

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Introduction:

Athletic training and athletic therapy (AT) education emphasizes skills-based assessment of the student while patient rehabilitation outcomes are ignored. Every AT program requires students (certification candidates) to fulfill academic and practical competencies such as during internships in order to learn, gain experience and to enter the certification exam process.[1-4] However at the conclusion of the program we assume the skills of the student have transitioned to being an effective health care professional, even though these outcomes are rarely if ever measured. While some AT's are getting athletes to return to play and maybe do not require a quantifiable rehabilitation outcome, a large percentage of our AT's work in a clinic setting.[5-7] Where rehabilitation outcomes are often used in other health professions including physical therapy and physiotherapy (PT), an ideal setting to evaluate the efficacy of AT internship students would be a student-run clinic.

Student-Run Clinic

A student-run clinic is a healthcare delivery program in which students, often medical students, are primarily responsible for logistics and operational management during clinic hours; and are capable of prescribing disease-specific treatment to patients.[8-10] The clinic is entirely run and organized by undergraduate medical students who are supervised by professionals in various disciplines, including social workers, family therapists, and physicians.[8] The prevalence of student-run clinics is higher in the USA (15%[11]), as it provides a solution for the healthcare system currently facing crises in cost, quality of care, and high rates of uninsurance.[8,12-15] A study compared patients with low back pain treated primarily by supervised student physical therapists with those of patients treated primarily by licensed physical therapists.[16] Plans of care designed and delivered were as effective in both groups of patients showing that the use of properly supervised students does not decrease the effectiveness of treatment services in patients with low back pain.[16] Overall, student-run clinics have many benefits for patients such as providing a cost-effective service to the community.

Learning setting

Student-run clinics provide a valuable learning setting. Learning is the acquisition of particular knowledge or skills built on that student's experience.[9,17,18] Experiential learning remains a fundamental element of health care professionals including medical education[16,19-24] and can be based on fictional cases, patient demonstrations during lectures, or observing a specialist. Students need to be placed in patient care situations and in a setting similar to that of the future profession in order to transfer the knowledge and skills gained in the classroom into clinical practice.[24-27] This is especially true in Athletic Therapy and Athletic Training where internships are required for programs to be accredited. There has been an increase in the number of real-time patient encounters used for teaching and evaluating athletic training students' clinical skills.[28-31] However in terms of evaluations, previous studies indicated that the evaluation of clinical skills in athletic therapy/training students were predominantly via simulations, while the use real-time patients was less frequent even if determined as the most reliable method of evaluation.[27,32,33]

Effectiveness and evaluation of student-run clinics

Data on student-run clinics are more prevalent in other health care professions and efficiency of students have been measured in different ways. In previous studies, researchers measured quality of care and effectiveness of student-run clinics based on either patients' satisfaction and overall reported positive and high satisfaction towards the process of consent, the amount of supervision, the safety and quality of care itself.[9,23,34,35] Moreover, some studies measured and quantified patients' outcomes in order to evaluated the effectiveness of treatments delivered by student compared to licensed professionals.[16,21-23,35,36] A systematic literature review examine different surgical disciplines like aesthetic, general, orthopedics, urology, ophthalmology, gynecology, and radiology and looked at a variety of outcomes such as mortality, morbidity, length of stay, amount of blood loss during surgery or interpretations of radiology reports. Overall, compared with faculty, care provided by residents resulted mostly in similar patient outcomes.[35] Another study compared patient outcomes after outpatient treatment by students (in occupational and physical therapies) and licensed therapists. Patients treated by licensed therapists tended to have fewer visits, shorter treatments duration (in days) and greater improvement of functional status compared to patients treated by students.[21] While a vast amount of studies focus on medicine,

nursing, physiotherapy, physical therapy and various professions, there are no studies to our knowledge that evaluate student athletic therapists rehabilitation outcomes.

Outcome measurements and Athletic Therapy

Athletic therapy and athletic training educations are designed to train a student to be a healthcare professional who specialises in the rehabilitation of active people, but we often do not quantify their rehabilitation improvement. Measurements of treatment outcomes are rarely completed by students. There is some evidence of physical therapy and medical students providing efficacious treatment.[9,16,21-23,34-36] However, there is no evidence regarding athletic therapy profession, especially on treatment outcomes achieved by supervised student athletic therapists in a context of student-run clinic such as at the PERFORM Center Athletic Therapy Clinic. Therefore, the purpose of this study is to evaluate improvement in function of patients suffering from a musculoskeletal injury upon receiving rehabilitation at a student-run athletic therapy clinic. Results of this study will improve the understanding of student-athletic therapist's performance in a clinical setting and will provide insight into the efficacy of student-led, therapist-guided athletic therapy treatment of patients with musculoskeletal injuries.

Methods

PERFORM Center Athletic Therapy Clinic

The PERFORM Athletic Therapy Clinic is an internship placement for athletic therapy students from Concordia University with certified athletic therapists as internship supervisors. Students can complete either their first or second clinical internship at the PERFORM clinic. The first clinical internship is of 400 hours and is for students generally in their second year of the Athletic Therapy program. The second clinical internship is of 200 hours and is generally for students in their fourth and final year of the university program. There are certain competencies that students must acquire in each internship which is the focus more than the hours completed. Student athletic therapists in this student-run clinic are in charge of performing all aspects of the patient management model, including taking a history, performing the physical assessment, determining key impairments, and designing an appropriate treatment plan for each patient's needs. This clinical setting is similar to a previous study with physiotherapist students using the Mayo Collaborative Model of Clinical Education.[37] Supervisors overview each assessment and

treatment plans and ensures appropriate tests and enquiries. Student therapists are allowed to make decisions with supervised independence. Initially, student therapists are given fewer patients in a day and increase towards more patients depending on their progress and schedule.

When a patient books an appointment with a student athletic therapist at the PERFORM clinic, the first appointment is a musculoskeletal evaluation of the injury. The evaluation lasts one hour and includes a) history-taking; b) observation; c) functional testing (active, passive, isometric/resisted); d) special tests; and e) palpation. Following the history-taking (step a), the student will leave the room to meet with the supervisor to debrief and determine the indices of suspicions. The student then returns to the patient to continue the evaluation (steps b to e). Once the evaluation finishes, the student goes back to the supervisor to interpret the findings and to formulate a clinical impression of the injury. Together they confirm the findings. The student returns to the patient in order to explain them their injury and their plan of action. The patient leaves the clinic with a few exercises or recommendations to follow at home until the next appointment which will consist of a treatment.

Each following treatment appointment lasts one hour. The student therapist is responsible for developing the rehabilitation program and prepares each treatment. The morning of the appointment during a case-conference, the student discusses the program with the supervisor. The student explains their aims of treatment and the plan of action, justifying the incorporation of the interventions and exercises included. As defined in the Athletic Therapy Competency Framework and Competencies by the Canadian Athletic Therapy Association, the rehabilitation program depends on the patient's needs and should include the following, but are not limited to: pre-exercise modalities, manual therapy techniques, exercise designed to increase range of motion or flexibility, strength, muscular endurance, and/or muscular power, proprioception (balance, coordination, and/or agility), post-exercise modalities, as well as patient education and any home exercise programs.[1-4,7,27] Student therapist are responsible for charting and documenting professional services rendered. At the end of each treatment, supervisors review and correct charting documents. Every following appointment, the student must thoroughly re-evaluate the patient, repeat tests and measurements, revise the rehabilitation goals, and modify the rehabilitation program (modalities and exercises) based on the needs of the patient.

Outcome measures

Clinician-based measures, such as ranges of motion and strength, are measures taken directly by the student therapist during the evaluation appointment. Patient-based measures evaluate a patient's perception as to health status in the form of questionnaires and survey scales.[38] We decided to evaluate outcomes using patient-based measures, specifically with region specific self-reported questionnaires in order to assess the patient's perception of the effect of a variety of diseases on a given region or body area.[38] Administration of self-reported questionnaires allows assessment of patients' perceptions of activities they can do, how often they do them, and the level of functional difficulty they have performing them, quantify physical, psychological, and social dimensions.[39] In general, there are two kinds of outcome questionnaires; questionnaires measuring the injury status in terms of disability or questionnaires measuring the injury status in terms of function. [40] We decided to describe the rehabilitation outcomes of injuries as improvements in function. We find that the term ″function″ is more positive and optimistic compared to the term ″disability″ and our goal is to have patients be fully functional as opposed to lacking any disability. Our decision to evaluate rehabilitation outcomes in term of function will influence our data analysis when calculating the score on various self-reported questionnaires since some questionnaire refers to level of disability. Depending on the area affected by the injury, patients filled one of three questionnaires: the Oswestry Disability Index (ODI) for low back injuries, the Lower Extremity Functional Scale (LEFS) for lower extremity injuries and the Disabilities of the Arm Shoulder and Hand (DASH) for upper extremity injuries.

Oswestry Disability Index

The Oswestry Disability Index[41] is a self-reported questionnaire used to measure disability in patients suffering from low back pain. The Oswestry Disability Index is the most commonly cited functional outcome measures in a chronic low back pain population.[42] The scale consists of ten subscales (Pain intensity, Personal care, Lifting, Walking, Sitting, Standing, Sleeping, Sex Life, Social Life, Traveling). Each subscale contains six statements. Each statement describes a greater degree of disability. Each subscale scored on a 0- to 5-point scale. Total score (/50) is doubled and expressed as a percentage. Maximum possible score is 100 while minimum possible score is 0, where higher score indicates greater disability. The minimal clinically important difference (90% confidence) for the Oswestry Disability Index is 10% (5 points).[43,44] When

baseline is taken into account, a 30% improvement is considered a generally useful guide.[43] The Oswestry Disability Index have been validated, tested successfully for reliability.[42]

Lower Extremity Functional Scale

The Lower Extremity Functional Scale[45] is a self-reported questionnaire used to measure the ability to perform everyday tasks in patients suffering from injury or pain to the lower extremities area, in other word measuring function. The Lower Extremity Functional Scale also contains all of the functional activities recommended by Harrison et al.[46] with the exception of kneeling. The scale is composed of 20 items. The scale rates the level of difficulty of functional tasks from 0 (extreme difficulty or unable to perform activity) to 4 points (no difficulty). The maximum possible score of 80 points, where higher scores indicate better function. The minimal clinically important difference is 9 points[45], also equivalent to 11.25%. The Lower Extremity Functional Scale was found to have excellent reliability with an r-score between 0.94 and 0.98.[45,47] Test-retest is reliable, valid, and responsive for use in patients with lower extremity musculoskeletal dysfunction.[45]

Disability of Arm, Shoulder and Hand

The Disability of Arm, Shoulder and Hand[48] is a self-reported questionnaire used to measure disability in patients suffering from injury or pain in the upper extremities area. The scale is composed of 30 questions on difficulty in performing different physical activities due to an arm, shoulder, or hand problem, severity of the symptoms, and on social activities, work, sleep, and self-image. Each question is on a 5-point Likert scale. The final score ranging from 0 (no disability) to 100 (most severe disability), where higher score indicates greater disability. There are two optional four-item scales (sports/performing arts scale and work scale) which we did not require participants to fill in our study. The Disability of Arm, Shoulder and Hand has 0.96 reliability[49], Person r> 0.70 validity[49], a 10% minimal clinically important difference[50,51] and good responsiveness.[52]

Participants and Protocol Procedures

The University ethics committee approved the study protocol (30004539). Data collection occurred over 11 months from September 25th, 2018 to August 26th, 2019 at the PERFORM

Center Athletic Therapy Clinic. We asked each person coming for an injury evaluation at the clinic to participate in the study. The researcher met the person before their first appointment to inform them about the study and to answer any questions related to the study. Each person signed the informed consent if they agreed to participate. Before the assessment appointment with a student therapist, once the person accepted to participate in the study, participants completed a region specific self-reported questionnaire depending on the location of the injury to assess their injured level of function. We used one of three scales: the Oswestry Disability Index (ODI) for low back injuries, The Lower Extremity Functional Scale (LEFS) for lower extremity injuries and The Disabilities of the Arm Shoulder and Hand (DASH) for upper extremity injuries. All participants attended their regularly scheduled rehabilitation sessions with their respective student therapist. Physical therapy intervention was not controlled, because the purpose of this study was solely to examine the measurement properties of the questionnaires.[47]

We assessed function again at 6-week by having the participants complete the same questionnaire they initially did at baseline. Participants were included if they were between the age of 18 years and 65 years old. We excluded participants if they had: multiple injuries, cancer, a non-musculoskeletal injury, an autoimmune disease, suffer from cervical or thoracic injury, suffer from a concussion, or did not intend to come back for treatment sessions and/or do not speak English or French. We also excluded from our analysis patients who only came for the assessment appointment or only one treatment appointment. We did not expect patients with only one visit or whose treatment duration was only one day to demonstrate change in function. Moreover, we did not analyse data from patients who had extremely long episodes of treatment or large numbers of visits because we believed they were patients who were receiving long-term intervention (i.e., in several cases up to 1 year). These people were planning on not being discharged in 6 weeks and therefore we not used in the study.

For confidentiality purposes, we used a subject number for identification during data analysis to conserve the identity of participants. Participants' information and answers on all the scales were then transferred into an excel file which have a code associated with it that only the principal investigator has access to. The excel file was saved on a laptop that has a security code needed to access the computer.

Demographic data

Upon patient's arrival, PERFORM Center requires patient to fill a health-risk questionnaire, including demographic, chronic disease, and mental health information. The information is entered by the receptionist into the ClinicMaster software (ADDATECH System Inc., Québec). The following independent variables were collected during the history-taking by the student therapist: age, sex, onset of condition, number of surgeries for condition, severity of the condition, the number of days from onset of symptoms until beginning intervention and whether the injury was acute or chronic. Chronic pain refers as pain lasting more than three months. For each patient, we recorded the clinical experience of the student therapist as completing their first clinical internship or second clinical internship. Lastly, we recorded number of treatments delivered in the 6-weeks timeframe and we measured amount of days and treatments from baseline to discharge.

Data Analysis

We calculated the score in percentage at baseline and at follow-up for every patient who completed the follow-up phase. Depending on the area affected by the injury, patients filled one of three scales: the Oswestry Disability Index (ODI) for low back injuries, the Lower Extremity Functional Scale (LEFS) for lower extremity injuries and the Disabilities of the Arm Shoulder and Hand (DASH) for upper extremity injuries. Of the three questionnaires, only the Lower Extremity Functional Scale was measuring function which means that a higher score refers to patients having more function. The Oswestry Disability Index and the Disability of Arm, Shoulder and Hand measure disability which means that a higher score indicates more disability. Therefore, we inverted the percentage scores for the ODI and DASH so that all scales were scored with a higher score indicating more function. Using the Dependent T-test, we calculated the difference in function percentage over time, from baseline to follow-up to obtain the improvement in function. We conducted separate ANOVAs to determine any significant change in function for each of the following variables: gender, body part (low back, lower extremity and upper extremity), clinical internship experience of the student athletic therapist and type of pain (chronic or acute). Finally, we conducted Pearson correlations to determine the relationships between the change in function and following variables including: patient's age, number of treatments received, and number of days between baseline and follow-up stages.

Results

Participants

We approached a total of 358 patients who came to the athletic therapy clinic at PERFORM Center for an injury evaluation. Of those patients, after exclusion criteria, we recruited 191 patients to participate in the study in the baseline phase. Fifty-nine (35.8 ± 14.6yrs) patients completed their questionnaire at follow up (32 women (54.2%): 38 ± 14.4yrs, 27 men (45.8%): 33.9 ± 14.7yrs) and were analysed. Figure 1 represents the consort diagram and the progress through the phases of inclusion and exclusion, baseline, follow-up, and analysis.

Injury site

Of the fifty-nine patients, 12 patients filled the Oswestry Disability Index (ODI) for low back injuries, 36 patients filled the Lower Extremity Functional Scale (LEFS) for lower extremity injuries and 11 patients filled the Disabilities of the Arm, Shoulder and Hand (DASH) for upper extremity injuries (See Figure 1 & Figure 2). Table 1 indicates the distribution of the locations of the musculoskeletal injuries.

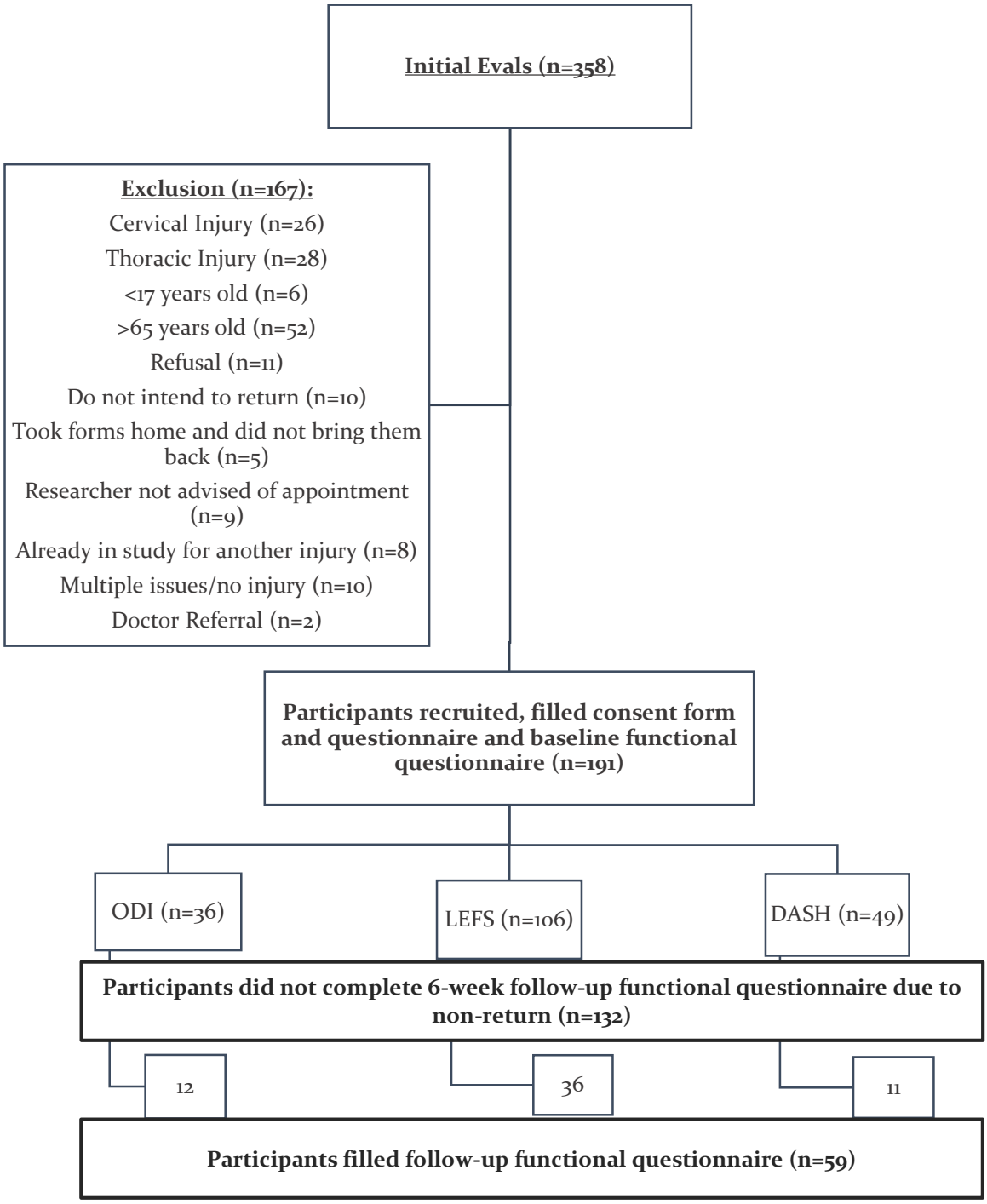

Figure 1. Consort diagram indicating the data collection process and patient drop out from patients seeking treatment at a student clinic for musculoskeletal injuries.

ODI Oswestry Disability Index, *LEFS* Lower Extremity Functional Scale, *DASH* Disabilities of the Arm, Hand and Shoulder

Body Part	Baselines	Follow-ups
Lumbar Spine	26	8
Pelvis	17	4
Hip	9	3
Glute	2	1
Leg	9	3
Knee	49	21
Ankle	19	5
Foot	8	2
Toe	1	0
Shoulder	32	8
Elbow	4	0
Arm	2	0
Wrist	8	2
Hand	2	1
Finger	2	0
Thumb	1	1
Total	191	59

Table 1. Distribution of body part injured in patients at the baseline stage and follow-ups stage in patient seeking treatment at a student clinic for musculoskeletal injuries.

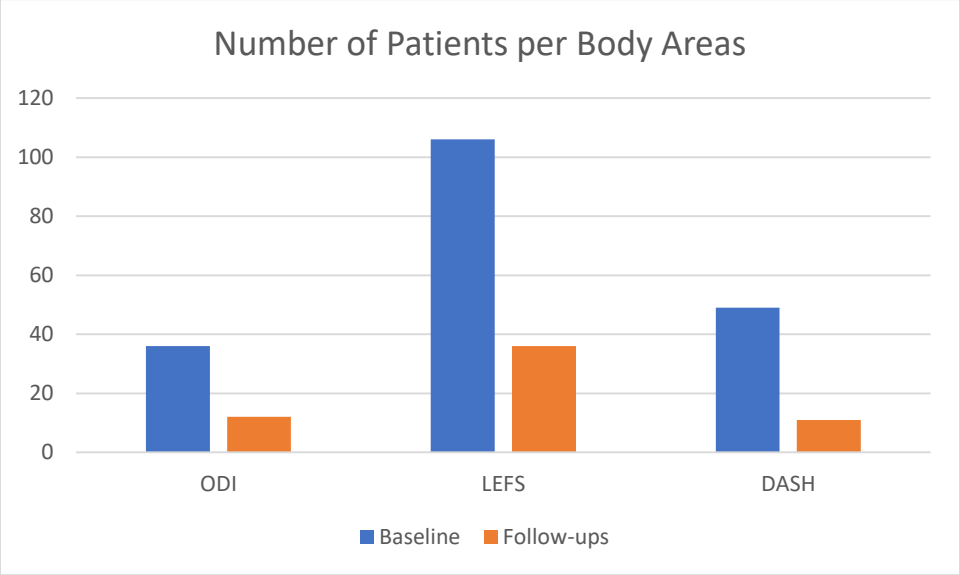

Figure 2. Bar graph indicating numbers of patients who filled the questionnaire for their respective injured body area at the baseline stage and follow-up stage.

ODI Oswestry Disability Index, *LEFS* Lower Extremity Functional Scale, *DASH* Disabilities of the Arm, Hand and Shoulder

Number of treatments

Patients completed the follow-up scale after approximately a 6-week period. Patients received an average of 4.7 ± 1.8 treatments across an average of 48.8 ± 16.1 days (see Table 2).

n=59		
Gender	Female	32 (54.2%)
	Male	27 (45.8%)
Age	Female	35.8 ± 14.6 yrs
	Male	38 ± 14.4 yrs
Scale	ODI	12 (20.3%)
	LEFS	36 (61.0%)
	DASH	11 (18.6%)
Pain	Acute	31 (52.5%)
	Chronic *	28 (47.5%)
Therapist Experience	1st Internship	44 (74.6%)
	2nd Internship	15 (25.4%)
Time Between Baseline and Follow-up	Treatments	4.7 ± 1.8
	Days	48.8 ± 16.1

Table 2. Demographic Information in patients including gender, age, scale filled, type of pain, experience of the student athletic therapist treating the patient and the time elapsed between baseline and follow-up stages.

*Chronic pain referred as pain lasting more than three months

ODI Oswestry Disability Index*, LEFS* Lower Extremity Functional Scale*, DASH* Disabilities of the Arm, Hand and Shoulder

Primary analysis: Function

Overall, people seeking treatment at the PERFORM Athletic Therapy Clinic experienced a statistically significant increase in function between assessment and follow-up (18.8% ± 20.3, $p < 0.001$) Patients were on average 66.7% ± 21.6 functional at baseline and after an average of 4.7 ± 1.8 treatments, patients experienced an increase in function to 85.5% ± 12.6. (see Figure 3, Figure 4 and Table 3)

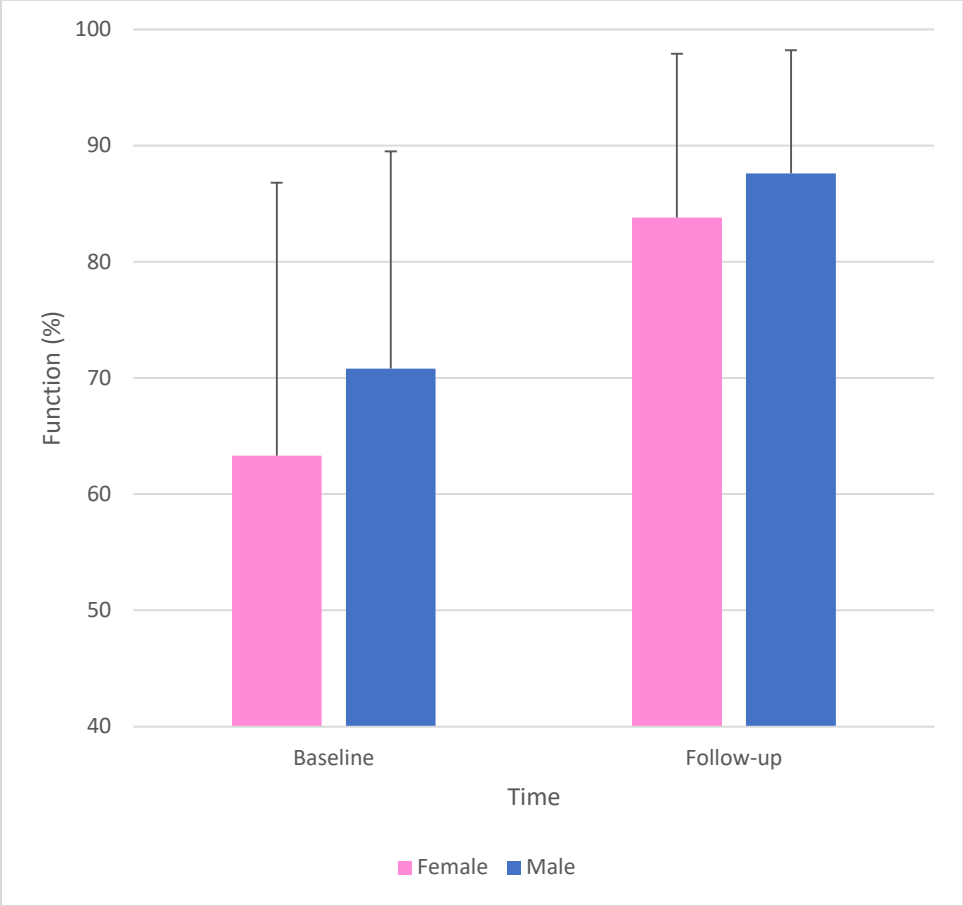

Figure 3. Bar graph representing level of function at baseline stage and follow-up stage and the improvement in function in male and female patients. Higher percentage indicates better function.

Injury site

There was no statistical difference in score at baseline ($p = 0.062$), at follow-up ($p = 0.104$) or in improvement between the three injury sites ($p = 0.471$). Patients with a low back injury (ODI) had an increase in function of 13.4% ± 13.6 (from 75.6% ± 12.4 to 88.9% ± 10.5). Patients with a low extremity injury (LEFS) had an increase in function of 21.3% ± 22.5 (from 61.5% ± 22.9 to 82.8% ± 14.3). Patients with an upper extremity injury (DASH) had an increase in function of 16.6% ± 18.7 (from 74.2% ± 20.8 to 90.8% ± 4.9) ($p = 0.471$). (see Figure 4 and Table 3)

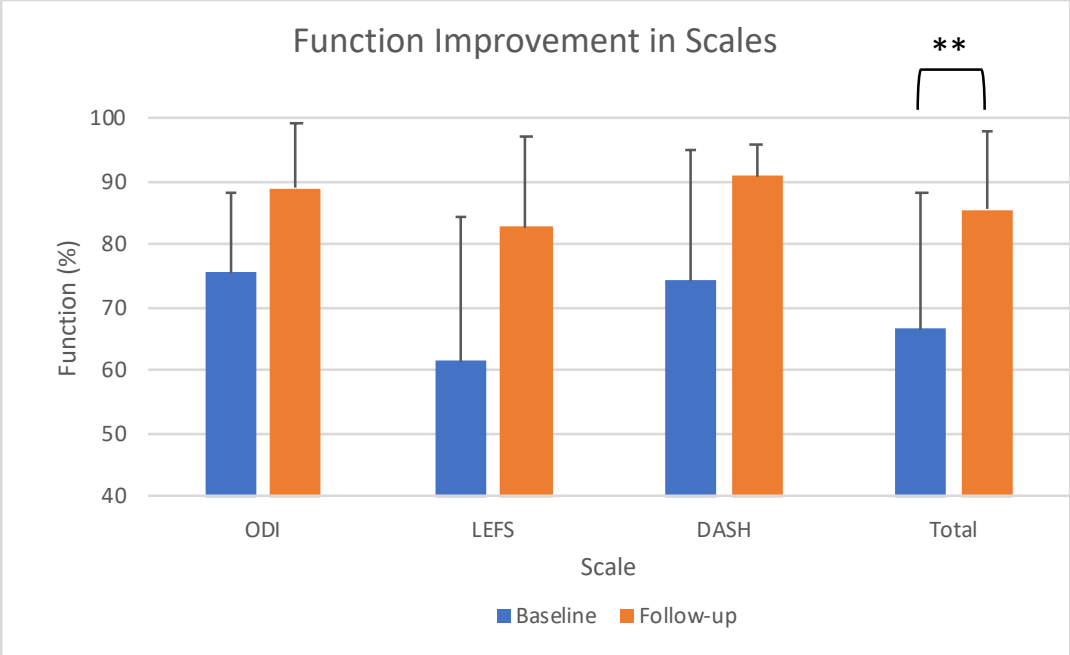

Figure 4. Bar graph representing the improvement in function in patients with low back pain (ODI), injuries to lower extremities (LEFS), injuries to upper extremities (DASH) and total injuries from baseline to follow-up stages.

* Statistical difference at the 0.05 level (2-tailed).

** Statistical difference at the <0.001 level (2-tailed).

Student therapists

Across the 11 months, the PERFORM Center Athletic Therapy Clinic supervised 22 athletic therapy students (15 students completing their first clinical internship, 7 students completing their second clinical internship). Of the fifty-nine patients, 44 patients were treated by a first internship student and 15 patients were treated by a second internship student. There was no statistical difference in function improvement regarding the student therapist clinical experience. Patients treated by a first internship student experienced an increase in function of 18.2% ± 21.5 compared to patients treated by a second internship student who experienced an increase in function of 20.5% ± 16.6 (p = 0.717) (see Figure 5 and Table 3).

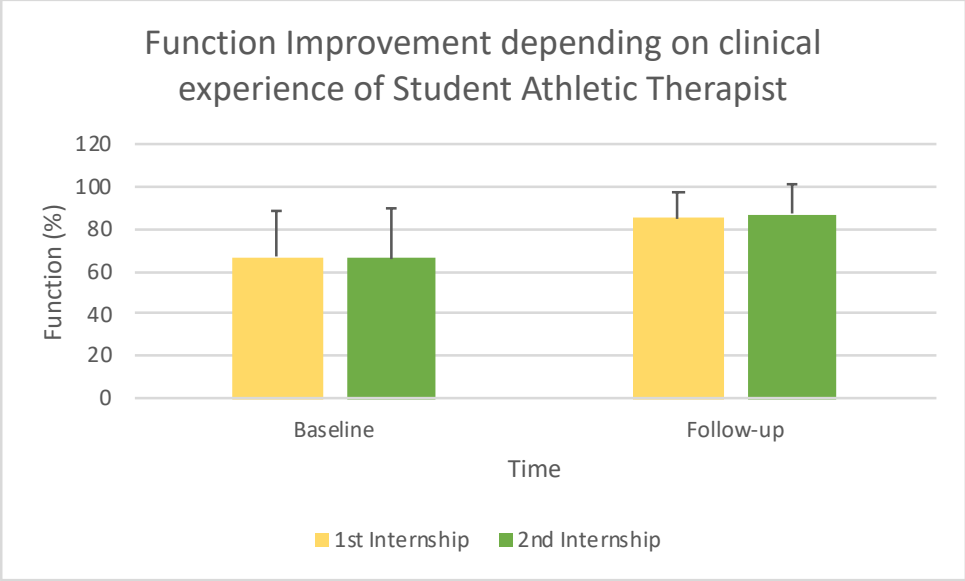

Figure 5. Bar graph representing the improvement in function in patients who got rehabilitation treatments from a student-athletic therapist in their first internship compared to by a student-athletic therapist in their second internship. Students in their second internship have more clinical experience than student in first internship.

Chronic pain

We wanted to assess if people with chronic pain were less functional than people with acute injury pain at baseline stage and at follow-up stage. Therefore, patients were split into people with chronic pain (injury lasting more than 3 months) and acute injuries (injury occurred within the last three months). While there was no significant difference in function at baseline between patients with acute injuries and chronic pain/injuries ($F = 3.96$, $p = 0.051$), there was a trend towards patients with an acute injury (61.6% ± 24.2) being less functional at baseline stage compared to those with a chronic injury (72.5% ± 16.8). At follow-up, there was no statistical difference between patients with acute injuries and patients with chronic injuries ($p = 0.079$). We assessed if people who experienced chronic pain did not improved similarly to people with an acute injury. There was a significant difference between patients with acute injuries compared to patients with chronic pain injuries comparing their improvement in function ($p < 0.001$). Patients with an acute injury improved more from baseline to follow-up (26.7% ± 20.6, from 61.6% ± 24.2 to 88.3 ± 12) compared to patients with a chronic pain injury (10.0% ± 16.1, from 72.5% ± 16.8 to 82.5 ± 12.9) ($p < 0.001$). (See Figure 6, Figure 7 and Table 3)

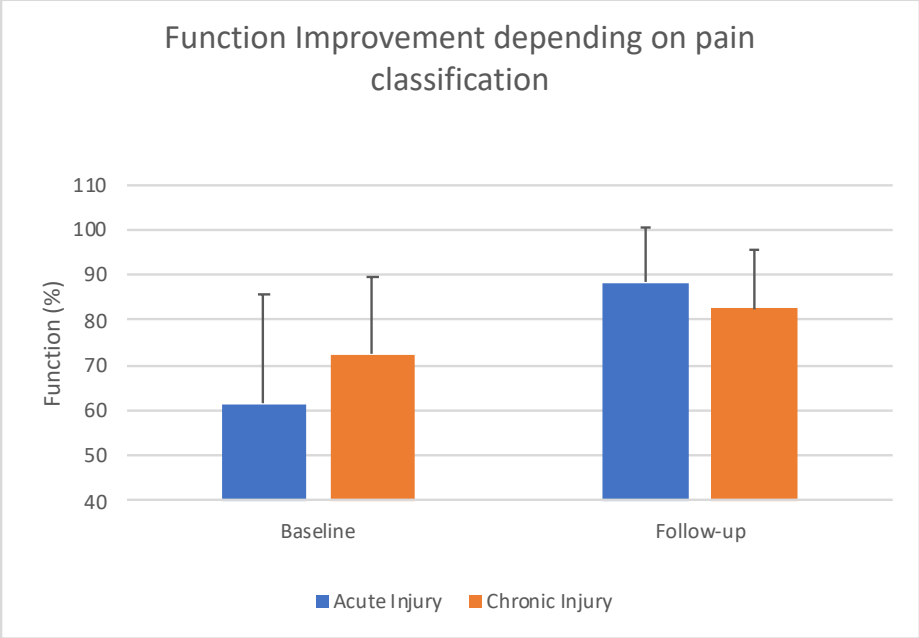

Figure 6. Bar graph representing the baseline and follow-up function in patients with an acute injury and compared to those with a chronic injury. Chronic pain referred as pain lasting more than three months.

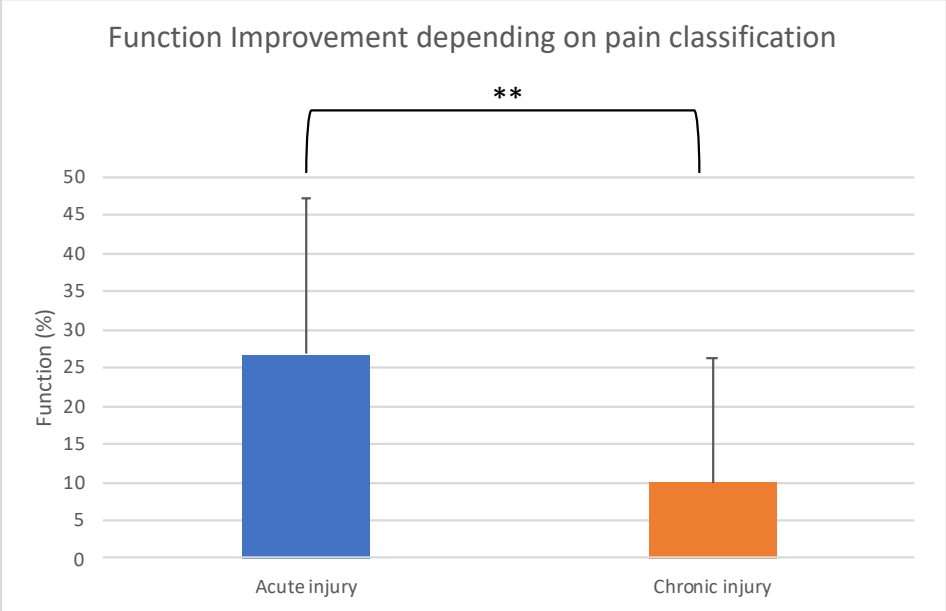

Figure 7. Bar graph representing the improvement in function in patients with an acute injury and compared to those with a chronic injury. Chronic pain referred as pain lasting more than three months.

* Statistical difference at the 0.05 level (2-tailed).

** Statistical difference at the <0.001 level (2-tailed).

		n=	Baseline Function (%)	Follow-up Function (%)	Change in Function (%)	*p*
Total		59	66.7 ± 21.6	85.5 ± 12.6	18.8 ± 20.3	0.001 **
Gender	Female	32	63.3 ± 23.5	83.8 ± 14.1	20.5 ± 23.8	0.497
	Male	27	70.8 ± 18.7	87.6 ± 10.6	16.8 ± 15.4	
Scale	ODI	12	75.6 ± 12.4	88.9 ± 10.5	13.4 ± 13.6	0.471
	LEFS	36	61.5 ± 22.9	82.8 ± 14.3	21.3 ± 22.5	
	DASH	11	74.2 ± 20.8	90.8 ± 4.9	16.6 ± 18.7	
Pain	Acute	31	61.6 ± 24.2	88.3 ± 12.0	26.7 ± 20.6	0.001 **
	Chronic	28	72.5 ± 16.8	82.5 ± 12.9	10.0 ± 16.1	
Therapist Experience	1st Internship	44	66.9 ± 21.1	85.2 ± 11.9	18.2 ± 21.5	0.717
	2nd Internship	15	66.2 ± 23.5	86.6 ± 15.0	20.5 ± 16.6	

Table 3. Statistical differences using ANOVA between level of function at baseline stage and follow-up stage comparing gender, scales, type of pain and therapist experience. Statistical difference using Dependent T-test between level of function at baseline stage and follow-up stage in total 59 patients.

ODI Oswestry Disability Index*, LEFS* Lower Extremity Functional Scale*, DASH* Disabilities of the Arm, Hand and Shoulder

* Statistical difference at the 0.05 level (2-tailed).

** Statistical difference at the <0.001 level (2-tailed).

Correlation analysis

There is a significant negative association between the age of the patient and the improvement in function (r = -0.288, $p = 0.027$). In addition, there was a significant association between the number of days between baseline and follow-up stages and the improvement in function (r =0.688, $p < 0.001$). Lastly, there was a significant relationship between the number of treatments between baseline and follow-up stages and the improvement in function (r = 0.331, $p < 0.001$). Patients who were younger and received more treatments had better improvements in function.

	Age	Number of days between baseline and follow up	Number of treatment between baseline and follow up	Change in Function (%)
Age	1	-0.055 (0.681)	-0.084 (0.529)	-0.288* (0.027)
Number of days between baseline and follow up		1	0.688** (0.00)	0.097 (0.467)
Number of treatment between baseline and follow up			1	0.331** (0.01)
Change in Function (%)				1
* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).				

Table 4. Correlation between age, number of days between baseline and follow-up stages, number of treatments between baseline and follow-up stages, and change in function.

Discussion

Overall, injured people from the community seeking treatment at an Athletic Therapy student-run clinic and treated by students significantly improved their function (18.8% ± 20.3, $p <$ 0.001). Whether patients were being seen for a low back injury, or upper extremity, or lower extremity injury, everyone's function improved after treatment (improvement of 13.4% for low back, 16.6% for upper extremity and 21.3% for lower extremity respectively).

Minimal Clinically Important Difference

Our main finding is that function improved in all patients and moreover patients significantly improved their function based on the minimal clinically important difference of each scale. The minimal clinically important difference represents the smallest amount of change in an outcome that might be considered important by the patient or clinician and that indicates the minimum amount of improvement required for your patient to feel a difference in measured function.[53] Regarding the Lower Extremity Functional Scale, the minimal clinically important difference is

9 points[45], also equivalent to 11.25% and when compared to our study, our patients had an increase in function of 21.3% ± 22.5 which is higher than the minimal clinically important difference. In regard to the Disabilities of the Arm, Hand and Shoulder, the minimal clinically important difference is 10%[50,51] compared to our study where patients had an increase in function of 16.6% ± 18.7. Lastly, the minimal clinically important difference (90% confidence) for the Oswestry Disability Index is 10%[43,44] and when baseline is taken into account, a 30% improvement is considered a generally useful guide.[43] In our study, patients had an increase in function of 13.4% ± 13.6. When compared to the 10% minimal clinically important difference, our patients did achieve the minimum amount of improvement required. Low back pain patients in our study did improve more that 10%, moreover they did improve using the minimal clinically important difference of 30% taking into account the baseline of 75.6%. Therefore, an improvement in function of 30% starting from 75.6% to 100% means an increase of 7.32% (30% x (100%-75.6%) = 7.32%). With both methods, our patients achieved the minimal clinically important difference of 10% and of 7.32%. Overall, patients with low back pain had the smallest amount of change in function and one reason is the challenge of treating low back pain. The diagnosis and treatment of chronic low back pain have been surrounded by debate, and there is no clear consensus on optimal management[42] which may be the reason for change in function below 30%. After a rehabilitation program by a student therapist, patients with a lower extremity, upper extremity or low back injury achieved but also had a bigger increase in function than the minimal clinically important difference determined for respective questionnaires.

Baseline Level of Function

Prior to the study, we were uncertain about the baseline level of function or how injured the patients would be compared to other clinics or studies. Based on the patients' level of function at assessment, our patients seen at the PERFORM Athletic Therapy Clinic were significantly injured.

In our study, at baseline, patients seeking treatment with a low back injury averaged 75.6% ± 12.4 as measured by the Oswestry Disability Index. A previous study examined treatment outcomes on low back pain patients and their levels of function at time of assessment was around 70-80 which seems to be the average function percentage for patients with chronic low back pain coming for treatments at a clinic.[54] In patients needing surgery, scores tend to be lower, about

55%.[55] People requiring surgery have a hard time doing many daily activities and will have a lower function percentage, but someone with chronic low back pain looking for treatment at a clinic their level seems to be higher. Lastly, a study in Finland conducted a controlled trial in an occupational health care center with patient suffering from acute, nonspecific low back pain. Their baseline levels were around 65% to 68% but it may be because their participants were on average older (40.2 years old) compared to our participants with low back injuries (34.5 years old) with a baseline function of 75.6%.[56]

In our study, at baseline, patients with a low extremity injury (LEFS) had a function percentage of 61.5% ± 22.9. This is similar to other studies examining patella femoral pain syndrome or just anterior knee pain which range from 61-75%.[57,58] The level of function of our patients is similar to these studies due to the fact that in our study, out of the 36 patients with a lower extremity injury, 21 patients came in with a knee injury. Also, we believe that function at baseline is similar because of the similar level of severity in the type of injuries and differential diagnosis compared to our people who came in at the PERFORM Center such as iliotibial band syndrome, patellar tendinitis, 1st degree ligament sprains and meniscal 1st degree tear. Furthermore, patients who presents themselves to the PERFORM Athletic Therapy Clinic with a lower extremity injury were those who had the least function at baseline and those who had the biggest improvement in function at follow-up.

Lastly, in our study, at baseline, patients with an upper extremity injury (DASH) had function percentage of 74.2% ± 20.8. Comparing to a study looking at different pathology, on average function at baseline was 65% and specifically people with carpal tunnel syndrome had function percentages around 59% ± 20.[59] A study looked at chronic elbow epicondylitis and one week before their first acupuncture treatment, patients had an average baseline function of 59.7%.[60] Regarding shoulder injuries, a study examined patients presenting with shoulder pain indicating subacromial impingement syndrome and their function at baseline was 42.4%.[61] Another study compare the effectiveness of routine physical therapy with and without eccentric strength training in patients with rotator cuff tendinopathy. On average patients had a function percentage of 43.7%.[62] Comparing to another study assessing traumatic hand injury patients with diagnosis such as finger fracture, tendon injury, soft tissue injury, fracture distal radius/carpals, and severe

crush, their pre-intervention functional measurements were of 55% ± 21.0.[63] Due to the different diagnosis and complexities of traumatic injuries that might consequently require different durations of intervention, participants were obviously less functional at baseline in this study compared to patients in our sample. There is a wide range of function in the DASH scale and if a patient suffers from an acute hand injury, this patient will have a very low score in function level looking at the questions such as opening a door and putting a seatbelt compared to someone with elbow pain. The DASH is more sensitive for elbow and hand function, and young and middle-aged individuals have a great ability to compensate while performing activities of daily living.[64] Perhaps, in our sample of 11 participants with upper extremity injuries, 8 of them had shoulder injuries. It seems like in a clinic setting, the timing and severity can influence the level of function measured at baseline. Overall, people coming to the PERFORM clinic were just as injured as other clinics or as in previous studies.

Years of Experience and Level of Expertise

The belief that expert therapists would be those with many years of clinical experience and the best treatment outcomes has guided some studies in their investigation in their quest to evaluate expertise and treatment outcomes.[65-68] Two studies verified the assumption that more years of experience are required to achieve superior patient outcomes. They found no difference in years of clinical experience between groups classified as expert or average.[39,69] A study by Constance[70], joined the affirmation and found no effect of therapists' years of experience on patient outcomes. Expert cannot be differentiated from therapists classified as average based on their years of clinical experience, sex, or professional degree.[39] Experts therapists had fewer patients than average therapists. One explanation may be that expert therapists have a smaller caseload. This could mean that therapists who manage fewer patients per day may spend more time with each patient, suggesting better treatment outcomes. In our study, there was no difference in case load or number of patients per day between students of first internship and students of second internship. Initially, student therapists had one or two patients in a day and increase towards more patients depending on their progress and schedule. Findings by Resnik & Jensen[69] suggest that therapists classified as expert were distinguished and correlate with academic and work experience, utilization of colleagues, use of reflection, view of primary role, pattern of delegation of care to support staff and by their patient-centered approach to care. At

the PERFORM clinic, student-therapists are encouraged to discuss with peers and supervisors and to reflect on their treatment plan during case conferences and during charting. Moreover, student-therapists have 60 minutes of one-on-one quality time with each patient which emphasizes on developing a patient-centered approach of care.

Clinical Internship Experience

What is interesting is that there was no statistical difference in function improvement in patients treated by a student completing their first clinical internship compared to patients treated by students completing their second clinical internship. The clinical experience or expertise level of the student therapist did not affect the functional improvement of patients during injury rehabilitation. Patients treated by a student in their first internship were improving as much as patients treated by a student in their second internship. Similar to few other studies[16,21,22,36,37,71], our results demonstrate that patients treated by student therapists achieved positive outcomes. One study compared outcomes of patients with low back pain after treatments primarily by supervised student physical therapist with outcomes achieved when treated by licensed physical therapists. Their results demonstrate that the plan of care designed and delivered by supervised student physical therapists was as effective as that of licensed physical therapists.[16] In a study comparing outcomes of a 2 days post-operation standardized protocol in patients with total knee arthroplasty who were treated by student physical therapists and licensed physical therapists, findings suggest no difference in outcomes and that the student physical therapists were as efficient as licensed staff.[22] We believe that since therapists had to follow a standardized protocol, the equivalency is understandable and expected whereas in our study, the treatment plans were not standardized and every patients had a different treatments designed based on their injury and needs. Lastly, while comparing treatment outcomes achieved by students in occupational and physical therapy programs, Rone-Adams et al[21] showed patients with low back pain who were treated by licensed therapists had a greater improvement in functional outcomes, a shorter duration of care, and fewer treatments. Another study, examining the effectiveness of treatment intervention by student physiotherapists, they showed significant improvement in function in scores on Lower Extremity Functional Scale and Neck Disability Index and improvement in scores for Disability of Arm, Shoulder, and Hand and the Roland Morris Disability Questionnaire. However, no comparison was made between outcomes by SPTs and

PTs.[71] In our study, even though we did not compare students to certified therapists, our patients got better after treatments by students-therapists. Our samples were not the same, 15 students in their first clinical internship (treating a total of 44 patients) and 7 students in their second clinical internship (treating a total of 15 patients). More people are needed to answer the question of if the internship makes a difference. Experience does matter but we believe that the part of the reason why we do not see a difference between the amount of improvement regardless of the experience of student-therapists is due to the difference in sample size but also linked to similar findings by Resnik & Jensen.[69] Experts therapists achieved better outcomes and were associated with spending more time with each patients, utilization of colleagues, use of reflection and their patient-centered approach to care.[69] We believe that students are more willing to stay in the room for longer and talk more with the patient because they have fewer patients to see. Students are taught to take a very detailed history and always look at the literature to determine what treatment to suggest.[1,4] We believe that the amount of work spent researching the injury, putting together a plan with supervisors are what contribute to improvement in function regardless of level of internship. We also believe that adequate supervision and the attention to the individual competence of students could positively serve patient outcomes. Further research is needed in order to compare treatment outcomes of patients treated by student athletic therapists and licensed athletic therapists and show if years of expertise would affect treatment effectiveness.

Cost-effectiveness

In an effort to balance quality service and minimize costs, student-run clinics such as PERFORM Center are offering health care services to the general public at an affordable rate due to the fact that services are delivered by not yet certified, student athletic therapists. The rate for an appointment at PERFORM Athletic Therapy Clinic is 30$ and the duration of every appointment is one hour. Our results show that overall, regardless of their injury region, people seeking treatment at the Athletic Therapy PERFORM Athletic Therapy Clinic got a statistically better and reflects the effectiveness of treatments provided by students therapists. Injury outcomes and low cost demonstrate the cost-effectiveness of student-run clinics such as the PERFORM Athletic Therapy Clinic.

Educational Benefit

Part of the competencies in Athletic Therapy is the intervention where students learn how to implement safe and effective rehabilitation protocols to address dysfunctions due to a musculoskeletal injury.[1,3,4] Students are taught principles of rehabilitation, therapeutic exercises, modalities and manual techniques. Evaluation of competencies in the education system is really good in class with midterms, good in laboratory with practice-exam and scenarios. Clinical skills are predominantly evaluated via simulations, whereas real-time patient encounters and standardized patients are the most reliable methods of evaluation but were used less frequently.[29,32,33]

Every Athletic Therapy program has an internship in order to be accredited and there are some learning objectives or learning competencies that have to occur at the internship. Internships are perfect to provide students opportunities to apply theory to clinical practice and for the first time students get to practice on real-time patients. Thus, student-run clinics provide excellent cost-effectiveness treatments for patient, service to the community and learning opportunity for students.

Limitations

One limitation for our study is that our consent form and inclusion criteria only covered participants under 65 years old. During the data collection portion of our study, 52 patients over 65 years old were treated in the clinic for a musculoskeletal injury however they were not included in our study. Prior to the study, we did not realize how many patients over 65 years old would be seen in the clinic so in the future we need to amend our IRB approval to include subjects over 65 years old. Indeed, our results are limited to people between 18 and 65 years old although athletic therapists treat people below 18 years and above 65 years of age.

The treatment was not standardized between patients therefore that can have an effect on the improvement in function. The principles of the treatment plans were standard (stretching if something is tight, strengthening if something is weak) however treatment programs were individualized, made on a case by case basis and are different between injuries and patients. However, despite the variability in treatment, the overall effect was an improvement in function.

A significant challenge of the study were patient follow-ups. Out of the 191 patients who filled out the functional questionnaire, 59 patients (30.9%) completed their questionnaire at follow up. We did not anticipate the number of dropouts or non-return of the 6-week treatments. Many reasons could explain the non-return of patients after the assessment appointment. Some may have stopped coming to their appointments because of lack of improvement or because their condition was getting worse, while others may have ended therapy early simply because they were improving and feeling better.[39] Some patient may have simply returned to their physician for a follow-up visit and not kept a subsequent athletic therapy appointment. Other patients may have left due to their insurance coverage plan. For many payers, services delivered by supervised student physical therapists that meet legal and regulatory guidelines are reimbursed equivalently to services delivered by licensed physical therapists. However, some insurance compagnies do not cover athletic therapy and the patient must request the addition of the service to their coverage plan. In study by O'Sullivan and Hickey[71], of the 160 patients, 55 (34.4%) completed questionnaires at both initial and final treatment sessions. Our challenge with follow-ups due to drop-outs illustrates a clinical reality that many public or private therapy clinics are facing, not just with the PERFORM Athletic Therapy Clinic but also any health care practioner.[16,39]

Conclusion

The health care environment is constantly changing and to achieve better outcomes in fewer visits is important for athletic therapists in order to demonstrate the value of treatment for the care of common musculoskeletal conditions and increase patient satisfaction.[36,72,73] What some find interesting is that our goal is to have a certified person who can get someone better but that is the one thing we do not measure. There is a lack when it comes to measuring outcomes of treatments during internship and measuring how student-treated patients improve. In order to evaluate quality of care of any service, it is important to record clinical outcomes that results from rehabilitation programs and treatments interventions. The use of outcomes measures at certain stages of the rehabilitation program can provide athletic therapists with a mechanism for assessing the progress of the patient, their injury and the effectiveness of the athletic therapy service.[38,74] Real-time feedback using self-reported functional questionnaire would help in order to know if what they do works. The goal is to generate someone who specialize in prevention, assessment and rehabilitation of injuries and athletic therapy student-therapists, as well as,

certified therapists, should measure the outcomes of the intervention/rehabilitation part. Athletic therapists treat a wide range of musculoskeletal injuries using various manual therapies, modalities, exercise prescription and even bracing and taping. The treatment varies but the goal remains to help clients return to their usual activities, whether it means playing competitive sports or simply walking their dog. Most patients are concerned about the effect of their injury on not only their sport-related activities but on their lifestyle, including the ability or inability to complete activities such as ambulation, dressing, bathing and participating in social activities. Return to normal function can be measured by the clinician and by the patient himself. Clinical outcomes are the end result of health care services and the clinician can use clinician-based measures such as range of motion and strength to assess outcomes. Patient-based measures requires the patient's perception regarding their health status in the form of self-reported questionnaires and survey scales. Patient-based measures should always be included in clinical assessment to identify what is important to the patient and as a routine follow-up during treatment sessions to assess progress and end results of the service.[38] Overall, at the PERFORM Athletic Therapy Clinic, patients improved their function significantly after treatment delivered by a student therapist and suggests that student-run clinics provide excellent cost-effectiveness treatments for patient, service to the community and learning opportunity for students.

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