

Influence of an Interactive Joint Model Injection Workshop on Physicians' Musculoskeletal Procedural Skills

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ABSTRACT. Objective. To assess the effect of an intervention workshop designed to improve intraarticular (IA) and periarticular (PA) injection skills among primary care physicians.

Methods. An interactive joint model injection workshop was designed for family practice and internal medicine residents and faculty, aimed at improving their skill performing IA and PA procedures. The workshop covered indications, contraindications, complications and supplies required to perform procedures, formulations of steroidal preparations, volumes used for injection, skin preparation, method of needle insertion, synovial fluid aspirations, aftercare, and processing of the synovial fluid. Interactive prewired models of shoulders, wrist, hand, knee, ankle, and foot provided feedback with an audible buzz for correctly performed procedure. A survey was administered immediately following the workshop and after 10 months.

Results. Of 60 participants, 39% were residents and 21% faculty. The mean age (\pm SD) of participants was 32.7 ± 7.7 years. The mean duration of followup was 10.5 months. The mean \pm SD comfort scores on theoretical and practical aspects of the procedures surveyed prior to the workshop were 4.8 ± 2.5 and 4.4 ± 2.5 , respectively; and after the workshop were 8.0 ± 1.7 ($p = 0.001$) and 7.8 ± 1.7 ($p = 0.001$), respectively. The mean change in comfort scores in practical aspects of IA and PA procedures did not correlate with the age of participants, but rather with their training/faculty status ($p = 0.01$). The mean changes in comfort scores with practical aspects of these procedures were highest among first-year residents (4.5 ± 2.1), followed by faculty (3.1 ± 1.7). On followup, the mean comfort scores on theoretical and practical aspects of the procedures were 6.3 ± 1.7 and 6.0 ± 1.8 , respectively, significantly higher than the pre-workshop scores ($p = 0.03$, $p = 0.02$).

Conclusion. Joint injection workshops using interactive joint models can improve the comfort scores of physicians learning IA and PA injection skills, in both theoretical and practical aspects of the procedure. Faculty and first-year residents in training seem to benefit the most; significant improvement in comfort scores was seen across the spectrum of physicians. Thus acquired comfort with knowledge and practical aspects of joint procedures may undergo attrition over time; however, significant residual benefits are still appreciable over time. (First Release May 15 2007; J Rheumatol 2007;34:1576-9)

Key Indexing Terms:

JOINT INJECTION WORKSHOP MUSCULOSKELETAL SKILLS

Arthritis is one of the most prevalent chronic health problems and the leading cause of disability among Americans over age 65 years. An estimated 43 million people in the United States have arthritis or other rheumatic conditions. The total cost of arthritis or related conditions in the US in 1997 was \$86.2 billion. Arthritis results in 39 million physician visits and more than a half million hospitalizations.

Intraarticular (IA) injections are an integral part of the

diagnosis of septic/crystalline arthritis and management of osteoarthritis, crystalline, and inflammatory arthritis. American College of Rheumatology (ACR) and European League Against Rheumatism guidelines for management of osteoarthritis of hip and knee joint support the use of IA corticosteroid injections, especially in cases of flare, associated with an effusion^{1,2}. Similarly, ACR guidelines for the management of monoarticular/pauciarticular flare in patients with rheumatoid arthritis support use of IA corticosteroid injections³. Thus primary care physicians need to be familiar with and also comfortable performing these procedures. In our study of Internal Medicine residents and faculty at a university program, only 19% of physicians admitted performing these procedures for their patients⁴. Further, the comfort levels with these procedures among the physicians were poor⁴. Others have also reported physician discomfort with these skills^{5,6}, which can potentially lead to medical-legal liabilities. Primary care physicians at community hos-

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pitals may not have experience similar to their university peers in comfort scores with these procedures.

We assessed the comfort levels with theoretical and practical aspects of performing IA and periarticular (PA) injections among our primary care physicians in a community hospital setting. We aimed at studying the influence of an intervention (in the form of joint injection workshops) on their comfort levels. Our null hypothesis was that of no difference in postintervention comfort scores compared to preintervention comfort scores.

MATERIALS AND METHODS

This was a longitudinal survey study performed at Christ Medical Center, Oaklawn, Illinois, a 662 bed, not for profit teaching, research, and referral medical center, affiliated with major universities in Chicago. It offers University of Illinois at Chicago based Internal Medicine (64 residents/yr) and Family Practice residency (24/yr) training programs. Participation in the workshop was voluntary.

Participants were Internal Medicine and Family Practice residents (year 1–3) and Internal Medicine faculty (teaching and private).

Joint injection workshop. The workshop was developed by the authors (MJ and SA) to educate Internal Medicine and Family Practice residents primarily in IA and PA injection skills as part of their residency training. Ten residents per workshop instructor were assigned at any given time. The workshop was offered in addition to any Internal Medicine or Family Practice faculty separately, in groups of 10 participants/session. Sessions were offered from October 2004 to September 2005. Each workshop was designed for a total of 110 minutes.

Each participant was given a survey sheet prior to the workshop, querying their age and training/faculty status, and their comfort with theoretical (question 1) and practical (question 2) aspects of performing IA and PA procedures. A visual analog scale from 1 to 10 was offered. Participants kept their survey sheets with them during the workshop. The reverse side of the survey repeated the questions on comfort levels, and these were completed after the workshop.

Theoretical comfort scores (TCS) referred to their relative comfort with the theoretical knowledge required in order to perform the common IA or PA procedures for their primary care patients. The main procedures included in this expectation referred to knee aspiration and injection, pes anserine bursitis injections, subacromial bursitis injection, and olecranon bursitis aspiration and injection.

Practical comfort scores (PCS) referred to their relative comfort with the actual performance of the common IA or PA procedures for their primary care patients. The main procedures included in this expectation referred to knee aspiration and injection, pes anserine bursitis injections, subacromial bursitis injection, and olecranon bursitis aspiration and injection.

A printed handout was provided with information on indications, contraindications, complications and supplies required in an office practice to perform these procedures, different steroidal preparations, their formulations and concentrations, volumes used for each injection, skin preparation, method of needle insertion, synovial fluid aspirations and aftercare, handling of synovial fluid, and tests to be ordered. A handout with pictures of anatomical landmarks for the procedures was given to each participant. These topics were covered by the instructors (MJ, SA) during each session. These 45 minute sessions were interactive and allowed for queries from participants and demonstration of the needles and other materials.

The next step was demonstration of the procedures by the instructors, using interactive models (Sawbones® models; Pacific Research Laboratories, Vashon, WA, USA) of shoulders, wrist, hand, knee, ankle, and foot. The demonstrations took roughly 45 minutes. The models are prewired for feedback, with an audible buzz if the procedure is performed

correctly. Participants were allowed 10–15 minutes to practice with the models. Supervision and guidance was provided throughout the practice session.

At the end of the study participants were asked to give their responses to the 2 questions and turn their survey sheets in. A followup survey with the same 2 questions was offered after 10 months to the Internal Medicine and Family Practice residents who had attended the workshop to gauge their comfort levels with the procedures.

Statistical analysis. To power the study at 90% with alpha = 0.05, to detect a mean difference of 2, with a standard deviation of 2, 13 participants with paired data were required. Descriptive statistics and tests were performed to determine if data were normally distributed. Paired t test to compare mean comfort score before and immediately after the intervention was done. ANOVA was utilized to perform stratified analysis. T test was used to compare the mean TCS and PCS from longterm followup with the preintervention and immediate postintervention results. P = 0.05 on 2-tailed analysis was considered significant.

RESULTS

The mean age of our 60 participants (faculty 21%, residents 79%) was 32.7 ± 7.7 years. Faculty participants (mean age 42.7 yrs) were significantly older than the residents (mean age of postgraduate year 1, PGY-1, 29.7 yrs; PGY-2, 29.2 yrs; PGY-3, 30.1 yrs).

Our data had a normal distribution. The mean TCS and PCS for joint interventions before the intervention were 4.8 ± 2.5 and 4.4 ± 2.5 , respectively (Table 1). The interquartile ranges were wide (Figure 1) and the scores lower prior to the intervention. Immediately after the intervention, the mean TCS and PCS were 8.0 ± 1.7 and 7.8 ± 1.7 , respectively. The scores were higher and the interquartile ranges tightened after the intervention (Figure 1). The mean change in TCS was 3.2 ± 2.2 (95% CI 2.6–3.7) and the mean change in PCS was 3.3 ± 2.0 (95% CI 2.8–3.8). These were both significant differences by paired t test ($p \leq 0.0001$).

The mean changes in TCS and PCS for the IA and PA procedures did not correlate with the ages of the participants. However, changes in the PCS correlated with participants' training/faculty status ($p = 0.01$; Table 2). The mean (\pm SD) changes in PCS were highest among first-year residents (4.5 ± 2.1), followed by faculty (3.1 ± 1.7 ; Table 2), although increments in both PCS and TCS were observed in all categories.

On longitudinal followup at 10 months, the mean PCS and TCS were 6.3 ± 1.7 and 6.0 ± 1.8 , respectively. Paired data were not available for these analyses; hence t test was

Table 1. Mean theoretical comfort scores (TCS) and practical comfort scores (PCS).

	Mean Score \pm SD
Pre TCS, n = 60	4.8 \pm 2.5
Post TCS, n = 60	8.0 \pm 1.7
10 month TCS, n = 15	6.3 \pm 1.7
Pre PCS, n = 60	4.4 \pm 2.5
Post PCS, n = 60	7.8 \pm 1.7
10 month PCS, n = 15	6.0 \pm 1.8

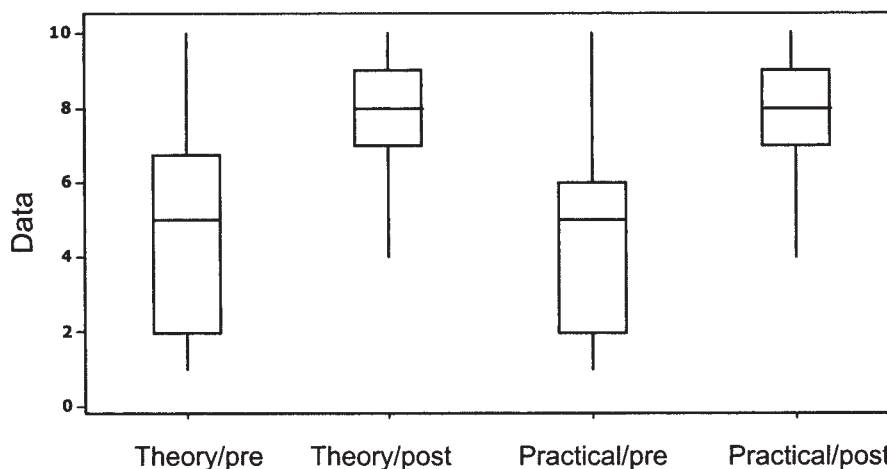


Figure 1. Distribution of preintervention and postintervention comfort scores in theory and practical aspects of joint procedures among workshop participants.

Table 2. Change in comfort scores by level of training.

	Mean Change in TCS (SD)	Mean Change in PCS (SD)
First year residents	3.95 (2.50)	4.5 (2.06)
Second year residents	3.33 (2.69)	2.88 (2.31)
Third year residents	2.50 (1.67)	2.33 (1.30)
Faculty	2.90 (1.51)	3.09 (1.70)
p	< 0.3	< 0.01

TCS: theoretical comfort score, PCS: practical comfort score.

used to compare means. Although there were significant declines of mean PCS and TCS over the time period compared to comfort scores immediately after the intervention, a significant increment persisted over the preintervention scores ($p < 0.03$ for TCS and $p < 0.02$ for PCS).

DISCUSSION

Primary care physicians are the first to encounter patients with musculoskeletal issues, including arthritis. Few physicians routinely assess⁷ or document⁸ musculoskeletal health during their history and physical examination. Physicians are not comfortable/confident with performing musculoskeletal evaluation⁹. Undergraduate training deficiencies in the musculoskeletal examination are widespread across US medical schools¹⁰. However, despite recalling “some teaching on the subject” as an undergraduate, 11.3% had “no confidence” and 62.6% had “some confidence” in musculoskeletal assessment⁹. Poor skills in performing IA or PA aspirations or injections are prevalent among primary care physicians. Less than 20% of physicians providing primary care perform IA or PA injection treatment for their patients themselves^{4,11}. All these factors have the potential of impairing or compromising appropriate and timely care among patients with musculoskeletal disorders.

Only a few studies address these problems. Literature on

this issue is partly available only in abstract form rather than a full report. A 200-hour dedicated rheumatology rotation for residents was found to be an appropriate intervention for cultivating meaningful patient care skills for musculoskeletal disease management¹². The study by Gardner, *et al*⁶ addresses these deficiencies; it is limited by its practicality for teaching programs without an anatomy laboratory. Recently, Wilcox, *et al* focused on an educational intervention to improve examination and injection skills¹³, also utilizing the Sawbones model; however, the sample size was small.

Dummy models are used routinely for medical training in anesthesia, emergency room practice, and obstetrics. We employed models that would provide a positive feedback for correct performance of the procedure. We observed 2 drawbacks with using the Sawbones models. They tend to deteriorate at the injection sites with repeated use, and we found that they do not provide the best anatomical landmarks, especially for the shoulder. Other injection simulation models are available commercially that allow aspiration to be performed; however, they are relatively more expensive.

The strength of our study is the community setting, larger sample size, inclusion of faculty participants, and the longitudinal followup. The limitations include lack of paired data from the 10-month followup. However, to maintain participants' privacy and offer a receptive learning environment, we chose not to use any subject identifiers. Also, the sample size for the 10-month followup data is small, and lacks data from the participating faculty. We chose to use a simple survey to obtain data, to encourage survey completion. Despite these limitations, this is the first study of longterm effects of an intervention workshop aimed at improving physicians' skills with IA and PA injections.

Based on our observations of increments in physicians' comfort scores in performing common IA or PA procedures, we would recommend use of similar workshops, aimed

specifically at first-year residents and graduate faculty. We observed that wide variations in participants' baseline comfort scores (which may be a reflection of variable educational curriculum practices) declined after such an intervention. This is a step toward providing a uniform standard of care for patients with musculoskeletal disorders across institutions, and decreasing the potential of medical-legal liabilities. Longterm effects of such interventions need to be studied further.

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