Musculoskeletal Exam and Joint Injection Training for Internal Medicine Residents

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We developed a musculoskeletal education intervention for internal medicine residents consisting of lectures, anatomic models, and a joint injection clinic. Written tests, observed musculoskeletal exams, and self-confidence scales were administered to 27 internal medicine residents before and after the intervention. Improvement was found in observed physical exam and self-reported confidence levels in performing knee injections. Confidence in shoulder injection skills improved, but remained low. Improved scores on written examination, though statistically significant, were not educationally significant. This single-institution pilot study demonstrates that a simple educational program results in improved knee and shoulder examination skills and confidence in performing knee injections.

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Primary care physicians are frequently exposed to musculoskeletal disorders such as knee osteoarthritis and shoulder impingement syndromes which can benefit from corticosteroid injections.^{1,2} Despite the frequency of musculoskeletal complaints encountered in ambulatory clinics however, primary care physicians report low confidence in performing musculoskeletal examination or corticosteroid joint injection. In a survey of primary care physicians to determine the use and level of comfort in performing intra-articular injections, 95% of respondents regarded themselves inadequately trained and 89% referred patients to specialty clinics for corticosteroid injections.³ This lack of confidence and comfort may stem from inadequate training in musculoskeletal medicine during medical school and residency. In the same study only 41% reported receiving a lecture on joint injection in medical school and residency, while only 40% received demonstration of the technique. In a survey of internal medicine residency program directors, only 36% reported that their residents master joint injection techniques.⁴ Implementation of an integrated, multidisciplinary course to teach knowledge and skills related to musculoskeletal disease to medical students has been shown to improve knowledge base and confidence level.⁵ We feel that internal medicine residency programs should also include formal training in musculoskeletal examination and joint injection techniques to better prepare physicians for careers in primary care.

The aim of this study was to improve training in musculoskeletal medicine for internal medicine residents through an educational intervention consisting of lectures, joint injection models, and a joint injection clinic. We aimed specifically to

improve confidence and skills in performing knee and shoulder examination and joint injections. We also aimed to increase residents' knowledge about common knee and shoulder complaints.

METHODS

The setting for the study was the University of Chicago internal medicine residency program. The program consists of 63 categorical residents who spend 4 months during their residency on ambulatory rotations. Before the study intervention, residents rotated through a variety of outpatient clinics, participated in an ambulatory morning report, and attended lectures on ambulatory topics during these rotations. Residents had an option of spending 1/2 day in the general rheumatology and orthopedic clinics as part of their ambulatory rotation, though no explicit curriculum focusing on the musculoskeletal exam or joint injection techniques occurred during these clinics.

Over the past year a formal musculoskeletal educational intervention was implemented during each ambulatory month to teach a focused musculoskeletal examination and joint injection methods for the knee and shoulder. Residents who rotated through the ambulatory block from October 2003 to May 2004 were consented to participate in a study evaluating the intervention. The University of Chicago Institutional Review Board approved the study.

Residents first completed a series of tests to evaluate their skills at baseline. The pretest consisted of 3 parts. The first was a written examination testing residents' knowledge of common knee and shoulder disorders, as well as their knowledge regarding contraindications and complications of joint injections (Appendix A). The second part allowed each resident to assess her own self-confidence in performing a shoulder and knee examination and injection (Appendix B). For the third part each resident performed an observed knee and shoulder examination. This was graded by a physician with training in proper examination techniques. A checklist was used to mark when a maneuver was performed properly (Appendix C).

The educational intervention consisted of 2 parts. In the first part residents participated in 2 1-hour workshops. One workshop consisted of a lecture focusing on common knee disorders, aspects of the knee examination, and knee joint injection techniques. The second workshop focused on the shoulder examination, common shoulder disorders, and shoulder injection techniques. At the end of each workshop residents performed joint injections using either a knee or shoulder injection model (Sawbones Worldwide, www.sawbones.com) while being supervised by a rheumatologist. The model gave positive feedback (a buzzing sound) when an injection was performed properly. In the final phase, residents

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on the monthly ambulatory rotation were scheduled to participate 4 hours a week in a dedicated injection clinic. The weekly injection clinic was developed and incorporated into the University of Chicago Hospitals Rheumatology clinic. A specific injection clinic did not exist previously, though injections were performed sporadically in the orthopedic clinic, pain clinic, or general rheumatology clinic. Patients were referred to the injection clinic by physicians in orthopedics clinics, the primary care group, and urgent care clinic and were able to be seen on average within 2 weeks of referral. The introduction of a designated therapeutic injection clinic improved the average appointment wait time for patients. Patients seen in the joint injection clinic most commonly suffered from degenerative joint disease, gout, impingement syndrome, or rotator cuff tendonitis. If residents did not have prior experience with joint injection techniques, they were able to observe at least one joint injection performed by an attending physician before performing a focused musculoskeletal exam and injection of the knee or shoulder. After the 3 step educational intervention was completed, the testing series was repeated.

Before and after scores on each resident were compared in each testing domain by Student's paired *t* tests (2-tailed distribution).

RESULTS

Fifty-eight second- and third-year residents rotated through the ambulatory block during the study period, and 27 residents participated fully in the educational intervention. Levels of participation varied between residents with 78% attending the shoulder workshop, 81% attending the knee workshop, and 67% attending both. On average, residents attended 2 joint injection clinics, performing 7.5 knee injections over the 4-week period. Unfortunately, since patients requiring shoulder injections were less common in clinic, fewer than half of residents performed a shoulder injection.

Improvement was observed after the educational intervention primarily in the domains of the observed physical exam and self-reported confidence levels. On the observed physical exam, mean score improved from 39% (SD 14.0) to 59.3% (SD 21.3) for the shoulder ($P < .001$) and from 49.8% (SD 16.7) to 68.3% (SD 21.9) for the knee ($P < .001$) (Fig. 1). On a scale of 0 to 10, with 0 representing no confidence and 10 representing maximum possible confidence, mean confidence ratings for performing a skilled knee examination increased significantly from 5.1 (SD 2.3) to 6.9 (SD 1.5) ($P < .001$) and from 3.6 (SD 2.9) to 7.8 (SD 1.7) ($P < .001$) for performing knee injections. Resident self-confidence improved with respect to performance of a shoulder examination (3.3 (SD 2.1) to 5.7 (SD 2.1), $P < .001$) and shoulder injection (1.1 (SD 1.6) to 3.7 (SD 2.2), $P < .001$), but the results were overall lower than that seen for knee injections. Confidence in understanding the appropriate use of steroids improved from 3.6 (SD 2.5) to 6.8 (SD 1.8) ($P < .001$) and in understanding the complications of steroid injections from 3.4 (SD 2.2) to 6.6 (SD 1.9) ($P < .001$, Fig. 2). On the written knowledge test mean scores improved modestly from 62.5% (SD 10.6) to 67.9% (SD 9.4) ($P = .009$).

DISCUSSION

A basic knowledge of the musculoskeletal exam and joint injection techniques is essential for all internal medicine resi-

FIGURE 1. Resident performance on observed musculoskeletal exams significantly improved after the educational intervention.

dents. The American Board of Internal Medicine requires that every internal medicine resident perform only 3 supervised arthrocenteses to be proficient in this procedure. Many residents might not feel confident to perform this procedure after residency training with such minimal experience. The educational intervention at the University of Chicago provided a tool for residents to gain more experience and confidence in performing both musculoskeletal examinations and joint injections by practicing on anatomical models and by participating in a dedicated joint injection clinic.

The educational intervention resulted in significant improvement in resident's competency in performing knee and shoulder examinations. Confidence in performing knee and shoulder examinations and in performing knee injections also increased significantly. Performance on a nonvalidated knowledge test, though statistically significant, was not educationally significant due to the relatively small increase in knowledge gains.

Previous studies have evaluated the adequacy of training of internal medicine residents in musculoskeletal examination. Vogelgesang et al.⁶ performed a study combining didactic lectures with joint injection models to review anatomy and teach joint injection techniques. There was no injection clinic component as seen in our study. In this study he was able to

FIGURE 2. Residents' confidence in performing musculoskeletal exams, joint injections, and using steroids significantly improved after the educational intervention.

demonstrate superiority versus no intervention, but was unable to measure pre- and post-intervention scores on each subject due to study design. Houston et al.⁷ implemented a program to improve training in musculoskeletal examination and joint injections for internal medicine residents by implementing a community-based musculoskeletal clinic. In this study residents saw more patients with musculoskeletal complaints and had the opportunity to perform more joint injections when compared with a standard housestaff continuity clinic. In contrast to the studies performed by both Vogelgesang et al. and Houston et al., our study included direct pre- and postintervention testing of knowledge base, observed joint examination, and resident confidence level.

Our study was performed at a single institution using second- and third-year internal medicine residents. The number of participants was limited by the small number of residents in the residency program, the fact that some residents had already rotated through the joint injection clinic prior to the defined study period, and the fact that some residents had 2 ambulatory blocks scheduled during the study period and therefore could not be studied twice. There were also disparities among the residents in the number of lectures and clinics attended due to the unpredictability of resident schedules. Despite this limitation, residents gained significant confidence and skill in performing a knee and shoulder exam and were confident in their ability to perform therapeutic knee injections. Gains in skill and confidence may have increased further with increased participation. Whether or not confidence in performing the injection reflected high levels of competency was not determined in this study. We believe however that increased confidence is an important endpoint as previous studies have shown a significant lack of confidence in regards to performing such procedures.³ While residents also gained skill in assessment and examination of the shoulder, the relative infrequency of shoulder injections performed in the clinic limited the capacity of residents to become independent in shoulder injections. It is evident that residents need more exposure to shoulder injections than is obtained through this intervention if they are to be expected to perform shoulder injections independently in the primary care setting. Because shoulder injections are used more sparingly than knee injections in the primary care setting, the attainment of knee injection skills is the more useful injection technique for primary care providers.

Another limitation of the study is the lack of a control group. This was difficult to obtain, as all internal medicine residents are required to rotate through the joint injection clinic during their residency. However, the ability to assess pre- and postintervention skills in our subjects is a strength of this study. Future areas of study include testing long-term retention of knowledge and confidence after the educational intervention as well as testing for competence in performing injections.

In summary, there is an established need to improve resident education and confidence in joint examination and joint injections. Potential ways to achieving this goal include more formalized lectures, use of anatomical models (which are readily available for purchase from a variety of internet sites), and rotation through an injection clinic to gain confidence and practical experience in performing injections. In this small pilot study we showed the potential benefits of such an intervention, including increased competency in performing shoulder and knee examinations and increased confidence in performing knee injections.

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Supplementary Material

The following supplementary material is available for this article online at www.blackwell-synergy.com

Appendix A. Musculoskeletal Written Examination.

Appendix B. Musculoskeletal Exam Confidence Scale.

Appendix C. Musculoskeletal Exam Checklist.