Inaugural MSK Medicine Module: An innovative multidisciplinary medical education model

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Abstract

Background

Given the increased need to enhance musculoskeletal education, an inaugural musculoskeletal (MSK) focused module was developed and evaluated as part of an orthopedic surgery training program at the University of Toronto. The educational offerings were based on a previously validated MSK Curriculum. Specifically, the aims are to evaluate the effectiveness of the module on 1) improving MSK knowledge and skills expected of graduating Orthopaedic residents and 2) the ability of residents to collaborate professionally with non-surgical MSK clinicians.

Methods

Nine residents initially selected to participate in the competency based curriculum for orthopaedic surgery completed this module as an essential component of their training. The module was experienced during the mid-point of training (PGY 3 equivalent). An evaluation template was developed using pre and post module multiple choice (MCQ) and short answer questions (SAQ) to assess knowledge; summary of in-training education reports (ITERs) of clinical educational experiences and; feedback obtained for scholarly presentations. Structured feedback was obtained from learners and educators to evaluate the effectiveness of the module and to inform changes to optimize future learning opportunities and environments.

Results

Nine residents completed the pilot study. The module was 8 weeks long. Learners rotated through clinical settings within five educational pillars. All residents demonstrated improvements in MSK medicine knowledge expected of graduating Orthopaedic residents with a 40% increase in mean MCQ scores (76% vs 60%; $p < 0.001$) and 58% improvement in mean SAQ scores (78% vs 47%; $p < 0.001$). Professionalism evaluations revealed performance above the expected level with a mean in-training education reports score of 4.19 out of 5 (SD: 0.44; range, 3.73 to 5).

Conclusion

Completing a MSK medicine module at the mid-point of postgraduate Orthopaedic training positively impacts acquisition of relevant MSK knowledge and skill, while facilitating interdisciplinary management of patients with MSK conditions using a new educational paradigm.

Background

The pressures of the changing postgraduate environment, including work hour restrictions to relieve surgical residents and increased emphasis on competency-based education rather than years studied, are catalyzing changes to training curricula. However, such changes threaten to reduce educational opportunities around the non-surgical management of musculoskeletal (MSK) conditions, as well as interaction with non-surgical MSK clinicians and allied health providers. MSK medicine curriculum content deemed to be important for health care providers to demonstrate in practice by World Health Organization and later a Canadian initiative is documented.^{1, 2} These concerns remain despite the increasing emphasis on patient-centered and interdisciplinary care in the contemporary health care environment. Further, the US Bone and Joint Initiative Summit³ has called for improved MSK education and the need to demonstrate competence in performing MSK physical exams, particularly at the graduate medical education level.⁴

Incorporation of MSK conditions in orthopedic surgical training is critical because MSK problems account for 10-20% of hospital visits. However, studies have shown that orthopedic residents lack MSK knowledge and confidence to work collaboratively with MSK providers.⁵ Dietrich et al. argue these gaps may exist due to divergent teaching approaches to MSK problems and lack of faculty confidence in teaching MSK conditions.⁵

As a result, orthopedic educators recognize the need for major curriculum reform in their residency programs as the conventional surgical education cannot adequately address the lack of MSK curriculum as is currently. In restructuring training programs, the Orthopaedic Surgery residency program at one large institution within Canada became modular rather than service-based to accelerate technical skill acquisition to reduce inefficiencies in training and provide frequent assessments, both summative and formative.⁶

As a result, the research team endeavored to develop a focused MSK medicine rotation as part of a competency-based Orthopaedic surgery training program. The development of this module was based on the work by Wadey et al, who performed as a medical education travelling fellow (METF) for the Royal College of Physicians and Surgeons of Canada (RCPSC) while at Stanford University in 2005. This study provided statistical evidence of agreement among educators (representing 77 Canadian accredited academic programs) that the Bone and Joint Decade Undergraduate Curriculum Group core curriculum recommendations for MSK conditions was thought to be important for residency education in several disciplines.²

Consequently, the objective of this study was to evaluate the module's effectiveness in terms of 1) improving MSK knowledge and skills expected of graduating Orthopaedic residents by regulatory bodies, 2) enhancing residents' ability to collaborate professionally with non-surgical MSK clinicians and allied health providers, and 3) the impact of this module on self-perceived benefits to both Orthopaedic residents and MSK clinicians serving as preceptors.

In this article, authors discuss the design of the curriculum including its goals and components. The study results intend to add evidence that a modular-based MSK module, with focused teaching of technical skills, frequent formative evaluations (e.g., pre and post module multiple choice, short answer questions, and a structured oral evaluation) and feedback on scholarly presentations can result in rapid acceleration in MSK knowledge acquisition and comprehensive professional skills development.

Methods

The development of the structure and learning objectives of the MSK medicine rotation was informed by the conceptual framework of patient-centered, interdisciplinary care based on medical MSK condition rather than clinician scope of practice (e.g., surgeon or non-surgeon). Learning objectives were based on previously published nationwide consensus musculoskeletal core curriculum objectives, as well as competencies expected of graduating Orthopaedic residents by the Royal College of Physicians and Surgeons of Canada. A subsequent integration meeting was held among musculoskeletal educators to discuss which components of the MSK curriculum may realistically be embedded within Orthopaedic surgery training programs. Outputs of this meeting include a Curriculum Map (Supplemental Content 1), developed to meet the requirements of Post-Graduate Medical Education (PGME) based on Objectives for MSK Medicine module and sample schedule (Supplemental Content 2).

An evaluation strategy was developed based on the CanMEDs framework (Supplemental Content 4), which categorizes competencies in seven domains for the medical specialist: medical expert, collaborator, manager, health advocate, scholar, professional, and communicator. Evaluation included competency in MSK knowledge tested using 1) pre- and post- module multiple choice (MCQ) with all sections conforming to RCPSC MCQ development of questions format, 2) short answer questions (SAQ) developed and content reviewed by an interdisciplinary group of MSK educators, as well as 3) objective structured oral examinations for Infectious Disease that also was content reviewed. All examinations were based on topics commonly tested on Orthopaedic certification examinations. Professionalism was evaluated using in-training education reports (ITERS), and a structured questionnaire soliciting feedback for the learner following a scholarly oral presentation to a group of interdisciplinary MSK clinicians and allied health providers was obtained. Finally, structured feedback was sought from both learners and educators concerning the overall effectiveness of the MSK medicine module as it is applied to the creation of a graduating orthopaedic surgeon. Descriptive and qualitative analyses were computed.

Over three years, a pilot cohort of 9 residents, 3 residents per year over the first three years of the pilot competency based curriculum (CBC) orthopaedic training program participated in this module at the mid-point of their Orthopaedic training (equivalent to the PGY 3 year). All participating residents played an instrumental role in reviewing the module at the end of each academic year, allowing the research team to review and modify the module to make improvements in real-time. Hence, in this study, authors are reporting the development the module, the results of the resident performance, and the overall impact of the module during the training of the initial 9 CBC residents. To demonstrate a commitment and

understanding to the entire MSK module, all residents were requested to sign an individual educational contract (Supplemental Content 3).

The pilot study was completed between 2011 and 2013 and is the first educational model incorporating a rigorous collaboration among other health care disciplines to provide educational offerings for the sole purpose of enhancing education of future orthopaedic surgeons. An example of a resident’s schedule may be seen in the supplemental content (Supplemental Content 5)

The research team obtained REB approval for education pertaining to the MSK module development and evaluation completed during the Orthopaedic Surgery residency program at the University of Toronto and is part of an overarching ethics approval provided for the Division of Orthopaedic Surgery as the first Orthopaedic Surgery Training Program to pilot the competency based curriculum format.

Results

The final module was designed to be 8 weeks in length, with learners rotating through a range of clinical settings within six educational pillars: infectious diseases, rheumatology, endocrinology and bone health, physical medicine and rehabilitation, pediatric, and chronic pain (Table 1).

Table 1
Identified areas of competency in musculoskeletal module

Educational Pillar	Topics Covered
Infectious Diseases	MSK infections assessment and management
Rheumatology	Arthritis, osteoporosis, spondyloarthropathies
Endocrinology and bone health	Metabolic bone disease, osteoporosis
Physical Medicine and Rehabilitation	Electromyography, nerve conduction test, ultrasound, and physical assessment
Pediatric	Skeletal dysplasia and genetics
Chronic pain	MSK pain assessment and management strategies

Following completion of the module, all 9 residents demonstrated improvements in MSK medicine knowledge expected of graduating Orthopaedic residents, with a 40% increase in mean MCQ scores (76% vs 60%; $p<0.001$) and 58% improvement in mean SAQ scores (78% vs 47%; $p<0.001$) (Table 2). Professionalism evaluations revealed performance above the expected level for all domains (collaborator, health advocate, and communicator), with a mean ITER score of 4.19 out of 5 (SD: 0.44; range, 3.73 to 5).

Table 2
Results of evaluations performed using quantitative assessment tools

	Prior to start of module	After completion of module	P value
MSQ score in percent (range)	60 (51-71)	78 (60-84)	<0.001
SAQ score in percent (range)	47 (36-65)	76 (63-94)	<0.001
OSCE score in percent (range)	-	79 (69-89)	-
ITER score in points out of 5 (range)	-	4.19 (3.73-5.00)	-

Qualitative analysis of scholarly oral presentation feedback consistently revealed successful knowledge translation to a range of MSK non-Orthopaedic and allied health providers. All trainees reported satisfaction with the rotation and identified specific benefits in terms of improved ability to diagnose and manage a range of MSK conditions, and better ability to refer and/or co-manage patients with non-surgical aspects of their disease. Of significance, educators from all MSK medicine disciplines reported high value in having Orthopaedic residents participate in their clinical learning environments. The orthopaedic residents were deemed to be an integral part of the clinical teams and contributed in a highly functional and collaborative manner. As a result, this module will be expanded to include all Orthopaedic residents for future cohorts entering into the training program.

Discussion

The results of this program evaluation demonstrate that the inclusion of a MSK medicine module at the mid-point of postgraduate Orthopaedic training provides benefits in terms of improving knowledge of MSK topics typically included on Orthopaedic certification examinations, as well as professional interaction and interdisciplinary management of patients with MSK conditions. Some factors documented in the literature that potentially contribute to the general improvement in the MSK knowledge acquisition include increasing dedicated clinical exposure to MSK conditions, an improvement and better integration of MSK learning resources within the program curriculum, and perhaps better self-directed learning strategies.

Despite this acknowledgement, there is little research exploring the benefit of developing a MSK curriculum in Orthopaedic surgical training through competency-based modules. Thus, to lend support to our study, we review research studies of other resident programs that have successfully explored the incorporation of MSK curriculum into their specialties (e.g., internal medicine, family medicine, physical medicine and rehabilitation, etc.).

In efforts to improve MSK training in family medicine residency, Dietrich et al. assessed the effectiveness of Advanced Primary Care Orthopaedic (APCO) in improving MSK exam knowledge and confidence through interactive small group learning and direct observation.⁵ These researchers highlighted the value

of mixed educational methods and small group learning to provide a standardized approach to MSK physical examinations and building confidence to diagnose MSK conditions. Dietrich et al. credit the success of APCO to its condensed length, integration of multiple joint exams, and intentional repetition of material.

Similarly, Wilcox et al. demonstrate the musculoskeletal educational intervention, consisting of lectures, anatomic models, and a joint injection clinic, developed for their internal medicine residents resulted in an improvement of observed knee and shoulder examinations as well as self-reported confidence in performing knee injections.⁷ Although improved written scores were statistically significant, it was not educationally significant due to small increase in knowledge gains. The significance of this study is the use of pre-and post-intervention testing of knowledge base, observed joint examination, and resident confidence level. These results are comparable to our study.

Another study by Battistone et al. assessed the feasibility and effectiveness of immersing interdisciplinary MSK curriculum in internal medicine, physical medicine and rehabilitation, and orthopedic surgery specialties to strengthen residents' clinical skills within existing rotations.⁸ As demonstrated by the objective structured clinical examination (OSCE), the week-long immersion was widely accepted by residents resulting in an increased self-reported ability to evaluate and manage shoulder and knee pain, and an increased competence in performing shoulder and knee examinations. Similarly, in our study, the MSK module was positively received by both learners and non-orthopaedic medical educators.

While some resource barriers may need to be overcome in expanding this module to all Orthopaedic trainees, the MSK medicine module has been made a mandatory module for all incoming residents at our institution with full support from all participating clinical disciplines. As Orthopaedic residency programs move toward a more competency by design medical education curriculum, and clinical practice environments continue to increasingly emphasize interdisciplinary care, the inclusion of a MSK medicine module may be helpful in preparing residents for both their end-of training certification examinations as well as for contemporary collaborative practice environments. This innovative educational model deserves further study to determine feasibility and acceptability of these novel methods for widespread adoption. This model offers a welcomed solution to today's challenging medical education environment.

To our knowledge, no previous study has attempted to develop and evaluate an MSK module developed with the intention to improve MSK knowledge expected of graduating Orthopaedic residents and their ability to collaborate professionally with non-surgical MSK clinicians and allied health providers. Continued feedback will be solicited by learners and educators to enhance the educational offerings and adapt to any programmatic needs for the residents. This innovative education model may align and contribute well towards the global need to improve musculoskeletal health via improved education.⁹

Strengths of this study include but not restricted to: 1) the evolution of an innovative multidisciplinary educational model for postgraduate education that demonstrated increase in knowledge, skills as well as

learner and educator satisfaction; 2) demonstration of a collaborative educational effort for the sole purpose of enhancing patient care and safety.

Limitations of this study include the small number of residents evaluated. We believe that the comprehensive nature of the evaluation process identified may provide insight into which predictive factors improve MSK knowledge and clinical performance. However, a larger study with more participants will allow for more conclusive decision-making.

Conclusion

Completing a MSK medicine module at the mid-point of postgraduate Orthopaedic training positively impacts acquisition of relevant MSK knowledge and skill, while facilitating interdisciplinary collaboration and management of patients with MSK conditions using an innovative educational paradigm. Learners and educators indicated a high degree of satisfaction with this education model. Future studies may evaluate the integration of similar educational modeling as it may apply to other domains and learning environments within medical education.

Abbreviations

MSK:	Musculoskeletal
MCQ:	Multiple choice questions
SAQ:	Short answer questions
ITER:	In-training education reports
METF:	Medical education travelling fellow
RCPSC:	Royal College of Physicians and Surgeons of Canada
PGME:	Post-Graduate Medical Education
APCO:	Advanced Primary Care Orthopaedic
OSCE:	Objective structured clinical examination

Declarations

Ethical approval and consent to participate

Ethical approval was granted for this study was obtained from the University of Toronto Ethics Review Committee in June 2007. Participation was voluntary and informed consent was obtained from all

participants prior to data collection. All methods were carried out in accordance with relevant guidelines and regulations

Consent for publication

All subjects involved in all methods have provided consent for participation and publication, whether written for the randomized controlled trial or verbal for the workshops and focus groups.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on request.

Competing interests

Not applicable.

Funding

Not applicable.

Author's contributions

MZ, DA, WK, BA, PF, AS, RM, TB, HS, HM, AB, RJ, EN, VE, AH, MN, and VW made substantial contributions to the study's conception and design, data collection, analysis and interpretation. TS and VW provided critical input in writing and preparing the manuscript for submission. All authors contributed to drafting, editing and revising the manuscript. All authors have reviewed various content of the manuscript.

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Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [1.CurriculumMapModule15MSKMedicineR.pdf](#)
- [2.ObjectivesMSKMedModule15.pdf](#)
- [3.InauguralEdContractCBCMSKMedModule.pdf](#)
- [4.EvaluationStrategyMSKMedicine.pdf](#)
- [5.ExampleofResidentSchedMSKMedModule.pdf](#)
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