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Intern use and perceptions of implementing diagnostic ultrasonography in a chiropractic educational clinic

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Objective: Use of musculoskeletal ultrasonography has been growing in many healthcare fields. Our aim is to evaluate the use and attitudes toward musculoskeletal ultrasound within a chiropractic educational clinic.
Methods: A survey questionnaire was distributed to interns (n=168), who were provided access to musculoskeletal ultrasound services for patients in our clinic. We collected self-reported usage and attitudes toward musculoskeletal ultrasound among interns in our clinic. Descriptive statistics summarized the data.

Results: The response rate was 60.1% (101/168). Overall, 31.7% (n=32) of respondents reported access of musculoskeletal ultrasound services. Ninety-one percent (n=29) reported the experience as beneficial. Identified benefits included: improved anatomic understanding, exclusion or confirmation of diagnoses, increased

Utilisation interne et perceptions de la mise en œuvre de l'échographie diagnostique dans une clinique éducative de chiropratique

Objectifs: L'utilisation de l'échographie musculosquelettique a augmenté dans de nombreux domaines des soins de santé. L'objectif est d'évaluer l'utilisation de l'échographie musculosquelettique au sein d'une clinique éducative de chiropratique ainsi que les attitudes liées à cette pratique.

Méthodes: Un questionnaire d'enquête a été distribué aux stagiaires (n = 168) qui ont eu accès aux services d'échographie musculosquelettique pour les patients de la clinique. On a recueilli des données autodéclarées sur l'utilisation et les attitudes envers l'échographie musculosquelettique parmi les stagiaires de la clinique. Des statistiques descriptives ont résumé les données.

Résultats: Le taux de réponse était de 60,1 % (101 stagiaires sur 168). Dans l'ensemble, 31,7 % (n = 32) des répondants ont déclaré avoir accès aux services d'échographie musculosquelettique. Quatrevingtonze pour cent (n = 29) des répondants ont déclaré que l'expérience était bénéfique. Les avantages indiqués comprenaient ceux qui suivent : une meilleure compréhension de l'anatomie, l'exclusion ou

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confidence, and patient reassurance. Of those that did not report use, 96% (n=66) reported interest in future use. Frequently reported limiting factors included: absence of indications for imaging, and patient ineligibility.

Conclusion: Our findings support musculoskeletal ultrasound implementation in an educational clinic to enhance student learning and confidence.

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KEY WORDS: *ultrasonography, diagnostic imaging, education, graduate, chiropractic*

la confirmation de diagnostics, une confiance accrue et une capacité de rassurer les patients. Parmi ceux qui n'ont pas déclaré l'avoir utilisée, 96 % (n = 66) ont exprimé un intérêt pour une utilisation à l'avenir. Parmi les facteurs limitants fréquemment signalés, on pouvait citer : l'absence d'indications liées à l'imagerie et à l'inéligibilité du patient.

Conclusion: Les résultats soutiennent la mise en œuvre de l'échographie musculosquelettique dans une clinique éducative afin d'améliorer l'apprentissage et la confiance des étudiants.

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MOTS CLÉS : *échographie, imagerie diagnostique, éducation, diplômé, chiropratique*

Introduction

Interest in musculoskeletal ultrasonography (musculoskeletal ultrasound) is growing in many healthcare professions, with its use being evaluated in an increasing variety of settings including rheumatology, pediatrics, orthopedics, physiotherapy, healthcare education, and chiropractic.[1-12] Musculoskeletal ultrasound has numerous advantages compared to other diagnostic imaging modalities including a lack of exposure to ionizing radiation, the ability to perform dynamic examinations, cost-effectiveness, time-efficiency, ease and accessibility to follow up and comparison imaging, and the ability for patients to ask questions regarding imaging findings directly to the performing and interpreting physician.[4,6,8,11,13,14] This combination can also allow the patient to avoid waiting for additional, more expensive, unnecessary imaging which can expedite diagnosis and treatment, and may provide faster relief of patients' concerns.[13] Additionally, as advances in ultrasound technology allow it to become more portable and affordable, its use is expected to become more accessible and universal.[15-17]

Musculoskeletal ultrasound has also been shown to have advantages within education as it provides exposure to common anatomic variants, demonstrates anatomic function and can reinforce the clinical relevance of anatomy and ultrasonography.[2,9,13,18,19] Instruction of anatomy using ultrasonography has recently gained traction within medical education with medical student surveys indicate that an ultrasound demonstration is a useful learning tool for reinforcing anatomy.[9,10,15,19,20] However, studies evaluating impacts on clinical skills demonstrate varied results.[9,18,20] Ivanusic *et al*.[18] used a demonstration of ultrasonography by an expert and student survey responses indicated that this experience reinforced material in a stimulating way and demonstrated clinically relevant anatomy. Other studies have shown that ultrasonography demonstrations can show clinical applications of anatomical knowledge and emphasize the importance of human anatomical variation.[19,21] The Ivanusic *et al*.[18] study specified that "ultrasound is best used to highlight specific anatomical features or concepts and used as an adjunct to other methods of teaching anatomy, rather than as a substitute for these."

One of the most frequently identified drawbacks of musculoskeletal ultrasound is user dependency with the quality and usefulness of the imaging being directly linked to the skill of the sonographer.[22,23] However, it has since been noted that standardization of image acquisition protocol and interpretation, as well as improvements in ultrasound training and technology have minimized the variability of results.[23-27] Additionally, validated semi-quantitative scales have been established for certain findings such as synovitis, which may further improve efficiency in interpretation.[25] Despite these advances, lack

of training remains a considerable obstacle to the implementation of musculoskeletal ultrasound in many clinical settings.[6,23,28] Other identified barriers include the cost of initial purchase and maintenance of the machine as well as the cost and time to complete appropriate training.[6]

The most commonly treated complaints in a chiropractic setting are musculoskeletal conditions. Thus, musculoskeletal ultrasonography is well suited for use in this setting. Some conditions commonly diagnosed with ultrasonography in our clinics include rotator cuff tears, collateral ligament injuries, calcific tendinopathies, bursitis, lateral and medial epicondylitis, Achilles tendinopathy, plantar fasciitis and peripheral neuropathy. Currently, only one study evaluated the current and prospective use of musculoskeletal ultrasound within chiropractic teaching institutions.[4] Another study described changes in accuracy of palpation following instruction with ultrasound.[2] Additionally, musculoskeletal ultrasound has been studied in its ability to support learning of palpation skills within physiotherapy, with mixed results.[22] In medical education, it has been suggested that use of musculoskeletal ultrasound as an extension of the clinical examination can improve immediate diagnosis of joint and soft tissue conditions as well as enhancing interventional skills. This may translate into improved patient outcomes in fewer follow-up visits.[6,9] Similar impacts may be seen within the chiropractic setting.

The aim of this study was to investigate the degree of intern utilization of provided musculoskeletal ultrasound services within a chiropractic educational clinic, as well as to explore the perceptions of the clinic interns regarding observation of musculoskeletal ultrasound exams and the influences of this on patient care. To the best of our knowledge this is the first survey of its type within chiropractic education.

Methods

We surveyed a convenience sample of student interns within a chiropractic college in the United States. The study was determined to be exempt by the university's institutional review board (#A-00200).

Access to diagnostic ultrasonography was initially added to the educational clinic of this chiropractic institution in May of 2019. At the time of survey distribution ultrasonography was available only to internal patients of the clinic; including fellow students, faculty, staff, and their families. The remaining patients, who are not directly affiliated with the institution, are considered external patients. During their clinical experience, student interns complete eight to 12 months of training within the institution's educational clinic: examining, diagnosing, and treating patients in an outpatient setting under the supervision of supervising faculty clinicians. The majority of students spend the final four months of training in university accredited, community-based internships under the supervision of practicing chiropractors. The authors invited all student interns enrolled in their first trimester of clinical internship to participate in this survey. The authors collected data during the Fall 2019 (n=70 interns) and Winter 2020 (n=98 interns) trimesters (n=168 interns).

Examinations were ordered following approval by supervising clinicians based on clinical exam findings and differential diagnoses. The interns who ordered the exams also attended the sonography appointments with their patients. Exams were performed by the radiology residents under the supervision of a registered musculoskeletal sonographer (RMSK). This allows both patients and interns to engage in discussion with the sonographer and get additional clarification beyond the finalized reports. The residents and sonographer are also educators within the program and intentionally include clinical pearls, review of relevant anatomic structures visualized on the scan, and discussion of differential diagnoses as part of the appointment. Following the ultrasonography appointments, interns completed an imaging narrative report where they correlate the need for imaging with the patient presentation, compare and contrast the benefits and limitations of the imaging modality, discuss the integration of the findings provided by the imaging with the clinical picture and other diagnostic information and describe how this influences the development of the patient's treatment plan.

An initial invitation was sent via email to all students enrolled in their first term as clinic interns. Follow up emails were sent to non-responders after two weeks. Participating interns completed a 10-item questionnaire that provided self-reported data regarding their use of and attitudes toward the inclusion of musculoskeletal ultrasound in their clinical training. The questions consisted of a mixture of yes/no, four-point Likert-type, multiple selection and open response formats. Each question also included an option not to answer. Development of the questionnaire was performed in accordance with survey design best

practices and content domains from the literature. The questionnaire was adapted based on the questions used in a similar survey by Acebes *et al*.[1] The authors pretested the questionnaire with content experts and students who were not involved in the study as investigators or participants. Following pretesting, grammatical revisions were made based on feedback received. The questionnaire was designed and distributed using the REDCap (Research Electronic Data Capture) platform.[29,30] Informed consent was obtained as part of the survey through REDCap. Respondents were not able to progress to the questionnaire without acknowledging the informed consent document and confirming their consent to participate in the survey. Study data were collected and managed using REDCap electronic data capture tools hosted at Parker University. REDCap is a secure, web-based software platform designed to support data capture for research studies, providing 1) an intuitive interface for validated data capture; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for data integration and interoperability with external sources.[29,30] A descriptive analysis of the survey data was undertaken.

Results

The authors received responses from 101 of 168 subjects surveyed, indicating a response rate of 60.1%. Overall, 31.7% (n=32) of those surveyed reported accessing the available musculoskeletal ultrasound services in the course of caring for patients. Of those who had accessed the musculoskeletal ultrasound services provided by the sonographers, 100% (n=32) reported imaging for 1 or 2 patients. These data are included in Table 1.

Of those who reported accessing the musculoskeletal ultrasound services, nearly all (91%, n=29) reported that they perceived the experience as beneficial. A majority of those (62.5%, n=20) indicated an extremely positive experience, while the rest (n=12) reported a somewhat positive experience. When asked about their likelihood to recommend the musculoskeletal ultrasound services, of those respondents who used musculoskeletal ultrasound in patient care, 78.1% (n=25) reported that they would be extremely likely and 18.8% (n=6) reported they would be somewhat likely to recommend it to other interns and patients. These data are summarized in Table 2.

Respondents indicated multiple perceived clinical benefits following their musculoskeletal ultrasound experience (Table 3) including: 46.9% (n=15) improved

Table 1.
Reported access of and interest in musculoskeletal ultrasonography services.

Access of Musculoskeletal Ultrasonography Services?	Yes (31.7%; n=32)			No (68.3%; n=69)	
# of Exams Attended	1-2 (100%: n=32)	3-4 (0.0%; n=0)	3-4 (0.0%; n=0)	Interest in Future Use?	
				Yes (95.7%; n=66)	No (4.3%; n=3)

Table 2.
Intern attitudes regarding the ultrasonography experience

Domain	Responses			
Beneficial	Yes (91.0%; n=29)	No (3.1%;n=1)	Chose not to answer. (6.3%; n=2)	n/a
Rate experience	Extremely positive (62.5%; n=20)	Somewhat positive (38%; n=12)	Somewhat negative (0.0%; n=0)	Extremely negative (0%; n=0)
Likelihood to Recommend	Extremely likely (78.1%; n=25)	Somewhat likely (18.8%; n=6)	Somewhat unlikely (0.0%; n=0)	Extremely unlikely (3.1%; n=1)

Table 3.
Summary of user and non-user's perceived and expected clinical benefits to musculoskeletal ultrasound experience.

Impact:	Users (perceived)	Non-Users (expected)
Improvement in anatomic understanding	46.9%; n=15	50.0%; n=33
Exclusion of differential diagnoses	65.6%; n=21	66.7%; n=44
Confirmation of clinical impression	59.4%; n=19	75.8%; n=50
Increased confidence in established diagnosis	50.0%; n=16	72.7%; n=48
Patient reassurance	75.0%; n=24	48.5%; n=32
None	0.0%; n=0	0.0%; n=0
Other	6.3%; n=2	4.5%; n=3
Choose not to answer	0.0%; n=0	0.0%; n=0

anatomic understanding, 65.6% (n=21) exclusion of differential diagnoses, 59.4%, (n=19) confirmation of clinical impression, 50% (n=16) increased confidence in an established diagnosis, and 75% (n=24) patient reassurance. Among those who selected 'other' benefits, in the open response section, one respondent reported that the results of the musculoskeletal ultrasound examination provided insight into the cause for inadequate response to care and allowed treatment plans to be modified to better align with the patient needs. Another indicated that the parent of a young patient appreciated being able to see the scan and have everything explained by the radiologists. Others noted the lack of radiation exposure and cost-effectiveness of the examination.

Of those who did not use musculoskeletal ultrasound, when asked to identify why they had not had an ultrasound interaction, the most commonly indicated response was "no indication for imaging at this time" (76.8%, n=53). Another identified barrier was patient ineligibility at the time of the survey (14.5%, n=10). The final barrier identified, lack of awareness that the service was available, was selected by 7.2%(n=5) of respondents. Of those respondents that did not report use, 96% (n=66) reported interest in future utility. These data are included in Table 1 and Table 4.

Table 4.
Reported barriers to accessing musculoskeletal ultrasound services.

Barriers to Use:	
External patient (ineligible)	14.5%; n=10
No indication for Imaging	76.8%; n=53
Did not know it was available	7.2%; n=5
Patient opted not to have further imaging	0.0%; n=0
Other	13.0%; n=9
Choose not to answer	0.0%; n=0

Of those who were not interested in accessing musculoskeletal ultrasound (n=3) the most commonly reported barrier to interest was that they did not think it would be helpful (n=2). The other reported barrier was the perceived difficulty in interpretation (n=1). Data regarding barriers to interest are shown in Table 5.

Table 5.
Reported barriers to interest from non-users.

Barriers to Interest	
Don't think it would be helpful	66.7%; n=2
Too difficult to access	0.0%; n=0
Scheduling issues	0.0%; n=0
Other	33.3%; n=1
Choose not to answer	0.0%; n=0

Of those who did not access musculoskeletal ultrasound at the time of survey, the expected benefits reported include: confirmation of clinical impression (75.8%, n=50), increased confidence in established diagnosis (72.7%,

n=48), exclusion of differential diagnoses (66.7%, n=44), improvement in anatomic understanding (50.0%, n=33) and patient reassurance (48.5%, n=32). These data, pertaining to expectations of non-users, are included in Table 3.

Discussion

The authors collected data to investigate the role that musculoskeletal ultrasound may play not only within a chiropractic clinic but particularly within a chiropractic educational clinic setting. This survey addressed Kirkpatrick's first level of effectiveness (reaction) but did not attempt to quantify the learning opportunity or impacts on the application of the knowledge in patient treatment.[31]

The American Institute of Ultrasound in Medicine (AIUM) identifies two types of ultrasound training. The first type is exposure, where students view others perform a scan, watch a video, or listen to a lecture. The second type is focused training, which is defined as hands on, active learning where students perform and interpret the scans themselves. Exposure is the most common method employed in medical schools and is the level of involvement evaluated in this study.[20,32]

The responses to this survey suggest that most students have a positive attitude regarding the addition of ultrasonography within the imaging component of their clinical education. Although only 31.7% (n=32) of respondents reported using the services, those respondents who had experience with the ultrasonography services all indicated that their experiences were either somewhat or extremely positive. Most respondents also reported that they were somewhat (18.8%, n=6) or extremely likely (78.1%, n=25) to recommend them to their patients and colleagues. These positive attitudes are similar to those within other professional and educational settings and support the addition of these services in this setting.[1,6,18]

Both users and non-users had similar attitudes regarding improvements in anatomic understanding and exclusion of differential diagnoses. Similar distributions were seen regarding these perceived and expected benefits accordingly. More non-users expected to have confirmation of their clinical impression compared to what was perceived among users. A similar trend was seen regarding increased confidence in an established diagnosis. However, more users reported increased patient reassurance than was expected among non-users.

We found high levels of interest in future use of musculoskeletal ultrasound among interns who had not yet accessed these services. This is similar to the findings from a survey of experts within chiropractic education and specifically diagnostic imaging [4]. These high levels of interest provide support for exploring implementation of ultrasonography within educational clinic settings moving forward.

Among respondents who did not use musculoskeletal ultrasound, the most frequently identified barrier was "no indication for imaging at this time." While we would like to see more interns learning from the available experiences with musculoskeletal ultrasound, this is encouraging as it suggests that interns are using clinical information and corresponding published guidelines to inform decisions about patient imaging.

Other identified barriers included patient ineligibility at the time of the survey. At the time of the survey the services were only available to internal patients: including fellow students, faculty, staff and their families. This was a temporary barrier and has been eliminated since the conclusion of this study. Musculoskeletal ultrasound services are now available to all patients within the institution's educational clinic.

A small number of interns were not interested in accessing musculoskeletal ultrasound, among them the most common reported barrier to interest was that they did not think it would be helpful (66.7%, n=2). This may be due to the relatively small amount of information that these students had been presented regarding the benefits and advantages of ultrasound within the curriculum. The other reported barrier was the perceived difficulty in interpretation (33%, n=1). At this institution, we attempted to mitigate this barrier by not requiring the students to perform interpretation, instead providing them access to the radiologist's interpretation and reports. However, this may have not been adequately communicated to the interns. Increased communication with the interns and their supervising clinicians regarding these expectations should be considered to help eliminate this barrier.

Reported benefits, which included patient reassurance, confirmation of clinical impression and exclusion of differentials were similar to those reported in other studies.[1,6,9] The addition of diagnostic ultrasonography within a chiropractic educational clinic may have positive effects on the learners' educational experiences.

Limitations

While the results of this survey are encouraging, there are limitations which must be acknowledged. First this was a convenience sample of limited size from a single educational institution both of which limit the generalizability of the results. An additional factor that must be considered is the impact of the COVID-19 pandemic. During data collection for this study, the COVID-19 pandemic was declared a national emergency, and the clinic at the institution was closed temporarily in response. As a result, the students were required to continue their clinical education virtually and were unable to report to the clinic or interact with patients. Musculoskeletal ultrasound services were also halted during this time. This further limited the opportunities for interns to interact with patients in addition to temporarily eliminating access to the musculoskeletal ultrasound services. The COVID-19 pandemic may have also impacted the response rate of the study as the authors were only able to contact the potential respondents virtually which may be associated with lower response rates.

Furthermore, while the survey instrument was adapted from another study[9], this is the first use of the finalized questionnaire. Thus, the instrument is not validated which may affect the reliability of the results and limit comparability to other studies.

Future directions

Since the conclusion of this study, availability of musculoskeletal ultrasound services has been expanded to all clinic patients. A follow up study is in progress to see if the increased availability has impacted use or attitudes. This follow up study will allow for validation testing of the questionnaire. Additional efforts have also been made to improve communication with the supervising clinic faculty doctors, and the interns to decrease the number of perceived barriers.

In future studies it may also be beneficial to survey patients who receive the services and compare this to their clinical outcomes. In other settings, musculoskeletal ultrasound has been shown to decrease the overall number of follow up visits, decrease the need for more costly follow up imaging, and can offer reassurance to the patient regarding their condition and potential outcome.[6,12]

Conclusions

The findings of this study demonstrate positive attitudes among interns toward the initial implementation of musculoskeletal ultrasound in a chiropractic educational clinic setting. This may result in enhanced student learning and confidence, as well as increasing patient satisfaction.

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