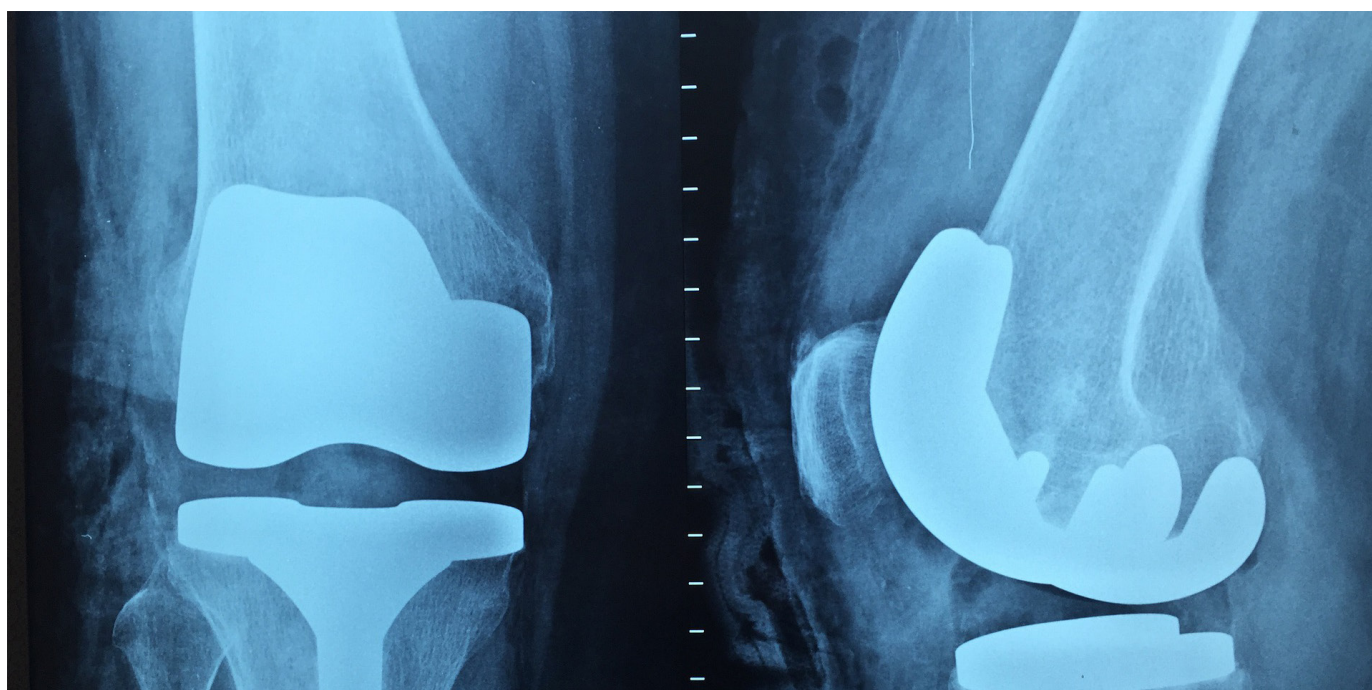


## Something in the way: How underrepresentation of trauma & orthopaedics in undergraduate curricula impacts the development of understanding and interest in musculoskeletal medicine

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### Abstract

Musculoskeletal (MSK) pathologies constitute a significant disease burden within our patient population. Many of these pathologies fall under the umbrella of trauma & orthopaedics (T&O). Medical school graduates should be confident and competent in their approach to identifying/managing these patients; therefore, their curriculum should reflect this requirement. A significant proportion of graduates do not display sufficient proficiency in MSK medicine which impacts our health service's ability to provide care for patients affected by MSK disease. This article explores how underrepresentation of T&O within undergraduate curricula is a contributing factor to this knowledge deficit. Furthermore, this article explores how underrepresentation may be contributing to a lack of gender diversity within the field of T&O. It is important that medical schools recognise the influence their curricula have on the development of specialty interest and strive to ensure a fair learning environment. In summary, this article discusses why it is important to have T&O exposure in undergraduate curricula with regards to ensuring graduates are well prepared to manage the burden of MSK disease and students are adequately exposed to experiences which will stimulate interest in MSK medicine.

### Abbreviations

GP – General practitioner

MSK – Musculoskeletal

OSCE – Objective Structured Clinical Exam

T&O – Trauma & orthopaedics

### Introduction

Musculoskeletal (MSK) disorders are the most common cause of repeat general practitioner (GP) appointments and constitute one in eight of all GP consultations that lead to a diagnosis.<sup>1,2</sup> Osteoarthritis is the most common joint disease in the world and it is estimated that almost 9 million people in the UK aged over 45 have sought treatment for it.<sup>3</sup> Therefore, orthopaedic knowledge is important for all medical professionals and for the majority this will be required in daily practice. Evidence suggests medical students' ideas, beliefs and interests in trauma & orthopaedics (T&O) mainly stem from experiences in medical school.<sup>4-9</sup> However, almost 20% of final year students have not experienced a single placement in orthopaedics,

and those who have spent on average only 2.5 weeks.<sup>4,5</sup> Given the large prevalence of MSK disorders, how does the undergraduate barrier of limited exposure affect students' interest and understanding of T&O medicine?

## Methodology

To identify appropriate articles focusing on UK medical students' MSK knowledge, a search was conducted using PubMed with the following search terms: "UK", "medical student", and "musculoskeletal knowledge", yielding 43 results. An advanced search was conducted with the original search terms using the following parameters: Title: 'musculoskeletal' OR 'knowledge' OR 'medical'; Filter: English language AND publication dates between 2002/1/1 and 2022/7/1 AND human species.

The advanced search yielded 22 results. Articles were then manually screened and those which discussed (or at least involved) UK medical students' or trainees' knowledge, understanding, opinion, or performance in MSK or orthopaedic medicine were further considered (n= 12). Studies based on or involving Irish medical students and trainees were then also excluded, resulting in a total of seven studies which met the inclusion criteria. These are outlined in **Table 1**.

## Results and discussion

### Impact 1: knowledge

Despite MSK disorders being one of the most common presenting complaints in modern day practice, they are woefully underrepresented in undergraduate curricula.<sup>4-9</sup> Subsequently, students may lack confidence and expertise in T&O, which may impact their interest in the speciality and motivation to develop knowledge of MSK medicine. Although lack of exposure impacts both those wanting to pursue a career in T&O and those who do not, evidence suggests students pursuing non-orthopaedic careers are disproportionately affected.<sup>5-8,10-12</sup> Almost 80% of graduates intending on pursuing non-orthopaedic specialities are deficient in their knowledge and understanding of the basics within MSK medicine.<sup>10-12</sup> Could this be due to lack of exposure or lack of interest? Graduates who have had greater undergraduate exposure or undertaken an elective or course involving MSK medicine during their undergraduate training showed much greater competence and understanding of T&O.<sup>5,10-13</sup> Even students who intended on pursuing a career in T&O showed greater competence with greater exposure during undergraduate study.<sup>11</sup> This suggests that limited undergraduate exposure, and not an absence of interest in T&O medicine, is the genesis of deficiency in MSK knowledge. Therefore, even if medical schools are unwilling to increase T&O placements, the promotion of related super-curricular activities such as courses and electives can help overcome this deficit and increase interest and understanding of T&O medicine.

From a global perspective it is clear there are deficiencies in knowledge and understanding of MSK medicine which may be attributed to limited exposure. However, to what extent does this affect UK medical students? Of the seven studies identified with the aforementioned search criteria, five displayed evidence of MSK knowledge deficiency in UK medical students (**Table 1**). Al-Nammari et al used the Freedman and Bernstein MSK cognitive examination tool to assess 210 recently graduated medical students.<sup>5</sup> The Freedman and Bernstein assessment is the most widely used tool for evaluation of orthopaedic knowledge and was originally validated in the US.<sup>12</sup> Only 21% of students passed this assessment despite 40% considering themselves competent in MSK medicine.<sup>5</sup> This corroborates data from non-UK studies which show low competence using the Freedman and Bernstein assessment tool.<sup>10</sup> Conversely, despite being widely used, it is not yet clear whether poor performance with the Freedman and Bernstein assessment tool is predictive of poor clinical performance. Therefore, it is difficult to extrapolate the deficiencies identified by

the Freedman and Bernstein assessment tool to clinical practice and hence conclude what impact this will have on patient care. Modern, validated assessment tools such as the MSK30 which place greater emphasis on clinical relevance have been developed but are not yet widely used. A novel MSK Objective Structured Clinical Exam (OSCE) used by Stansfield et al identified significant deficiencies in examination skills needed to diagnose common MSK disorders in graduating UK medical students.<sup>14</sup> This may indicate that deficiencies identified by the Freedman and Bernstein assessment tool do carry over into clinical practice. However, this study involved US medical students and so it is difficult to conclude if these findings are shared among the UK population. More UK based studies looking at clinical performance in MSK medicine are required.

Since there are deficiencies with the Freedman and Bernstein assessment tool, what results do alternate methodologies yield? Of the remaining six studies selected for this review, three used a questionnaire format, two used computerised assessments and one involved annotation of a diagram to assess MSK knowledge.<sup>4,15-19</sup> Of the survey-based studies all showed deficiencies.<sup>4,15,16</sup>

Of the questionnaires, two involved self-rated competence with the major criticism of this methodology being that it may not be indicative of true competence in MSK medicine (as highlighted above by the discrepancy in student's self-rated competence and actual competence in Al-Nammari et al's study).<sup>4,5,15</sup> Despite this criticism, Atrey et al formally assessed knowledge in essential T&O topics alongside self-rated confidence in T&O before and after an education programme and noted there was a correlation between improved knowledge post-programme and self-rated confidence.<sup>16</sup> This suggests that low self-rated confidence may be linked to low competence in MSK medicine. However, overall the literature shows conflicting data on the relationship between improved self-rated confidence and increased MSK knowledge so further research is required to provide a definitive answer to this question.<sup>13,16,20</sup>

Of the two studies that utilised computerised assessments, both suggested knowledge of MSK medicine is adequate in undergraduate education.<sup>17,18</sup> One looked at knowledge in MSK medicine as compared to neurology and cardiovascular medicine and the other directly assessed knowledge from first to final year of medical school using a standardised progress test.<sup>17,18</sup> Both showed adequate knowledge of MSK medicine in their respective populations but it must be noted that both studies involved medical students from only one University so difficult to ascertain whether the results are a representation of this University's curriculum or the UK medical student population as a whole. Given that there are few studies which corroborate these findings, it would be difficult to conclude with certainty that undergraduate curriculums are adequately preparing medical students in the field of MSK medicine in the UK.

Spielmann et al used a basic test to assess MSK knowledge involving labelling of the carpal bones on a diagram.<sup>19</sup> This is a crude methodology in comparison to previous studies but provides an objective, though narrow, view of MSK knowledge in medical students and postgraduates. Only 30% of participants were able to correctly label all eight carpal bones and most medical students identified fewer than five.<sup>19</sup> This suggests that anatomical knowledge is poor within the medical student population. The sample size of this study was small, however, involving only 50 participants. These results have been replicated with a population of 111 medical students but it must be noted that they were from Irish medical schools.<sup>21</sup> As an example of the importance of MSK knowledge, in particular the anatomy of carpal bones, scaphoid fractures are a common presentation within clinical practice and the identification of this boat-shaped structure is important for all clinicians, not just MSK practitioners. The annual incidence of scaphoid fractures in the UK is estimated to be between 12.4 and 29 per 100,000 making it the most frequently fractured carpal bone.<sup>22</sup> Hand/wrist injuries are one of the most frequently misdiagnosed conditions and failure to identify scaphoid fractures can predispose patients to chronic



hand/thumb pain, early onset osteoarthritis and need for invasive surgery.<sup>23</sup> In view of the evidence currently available within the UK population, MSK knowledge is inadequate within medical students, but further research is required to inform what revisions are required within undergraduate curricula.

### Impact 2: gender diversity

In the UK, over 50% of medical students are female yet they often account for less than 15% of orthopaedic surgeons, making orthopaedics the least gender diverse surgical specialty.<sup>7,9,24-27</sup> Although female representation is increasing, it still lags behind other specialities.<sup>9,24-26</sup> Diversifying the orthopaedic field and widening interest in T&O is important not only for the speciality itself also but for the aforementioned high prevalence of MSK disorders.<sup>26</sup>

Research suggests that increased exposure to orthopaedic content during undergraduate study is positively associated with the number of female applicants for orthopaedic surgery.<sup>7,8,9,29</sup> Furthermore, although there is a positive influence from increased exposure regardless of gender, the influence is much more pronounced in female students.<sup>7</sup> This is further supported by evidence suggesting males are more likely to develop their interest in T&O prior to clinical rotations, in contrast to females who are more influenced by their clinical experiences.<sup>9</sup> This discrepancy can be explained by role modelling being an important factor in the development of interest in career speciality, especially with regards to encouraging female interest as almost 70% of female graduates highlight lack of strong mentorship in medical school as a factor for not choosing orthopaedics as a career.<sup>7,8,27,29-31</sup> Therefore, one could surmise that increasing undergraduate exposure to T&O may increase interest in both MSK medicine and T&O as a career for both male and female students. Female students are more likely to benefit from greater exposure during clinical years and this may help diversify T&O homogenous population by stimulating career interest.

Conversely, there is data to show that extensive orthopaedic exposure does not exert significant influence in the development of interest in T&O.<sup>29,32</sup> Although early exposure to MSK medicine is acknowledged to be influential for female students, intrinsic factors such as work-life balance and physicality may be more influential in determining interest in T&O.<sup>29,32</sup> Subsequently increasing orthopaedic exposure alone may not be sufficient.<sup>29,32</sup> However, only 27% of the cohort sampled reported moderate to extensive orthopaedic exposure as part of their undergraduate curriculum, and although this did not influence their interest in the specialty, it is difficult to conclude the impact lack of exposure had on the remaining 73% of students.<sup>32</sup> The majority of research in the field supports the idea that increasing undergraduate exposure to T&O has a positive impact, and the evidence as a whole is in favour of increasing orthopaedic exposure as a means to encourage greater female interest. However, to further maximise interest it is important that attention be paid to mentorship, and in particular same-sex mentorship, as this has been shown to be influential in stimulating female interest.<sup>7,8,27,29-31</sup>

## Conclusion

Undergraduate curricula do not reflect the current disease burden of MSK disorders in clinical practice by providing limited exposure to T&O. Lack of undergraduate exposure to T&O has significant bearing on MSK knowledge deficiencies in medical students and graduates and may be a contributing factor to female underrepresentation in orthopaedic surgery. Clinical exposure to T&O is essential in stimulating career interest in addition to developing proficiency in MSK medicine as a component of medical practice. I suggest greater emphasis be placed on:

1. Increasing undergraduate exposure via clinical placements
2. Encouraging electives/courses involving MSK medicine
3. Increasing mentorship for both male and female medical students

These three points benefit all medical students by increasing competence, confidence and understanding of MSK medicine. This is likely to be of significance in all fields given MSK pathologies high prevalence in our population.

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## Sam Ghaznavi

My name is Sam and I am currently a 5th year medical student at peninsula medical school. I am interested in trauma and orthopaedics, in particular arthroplastics and regenerative medicine, as well as medical education. I intend to pursue a career in orthopaedics in the future.

**Table 1**

Study	Methodology	Results	Conclusions	Comments
Malik-Tabassum et al <sup>4</sup>	Survey of 414 final year medical students attending a 1-day T&O course. Measured outcomes included duration and perceived quality of T&O teaching as well as students self-rated competence.	37.4% of students described their training as "poor" with 19.3% not having experienced a single T&O placement. Self-rated competence was low in all basic T&O skills.	Inadequate undergraduate training and exposure to T&O with students having low confidence in basic skills.	<p>Strengths:</p> <ul style="list-style-type: none"> <li>• Good sample size with students from a wide range of UK medical schools.<sup>13</sup></li> <li>• Survey involved scenarios which are akin to real practice in comparison to other methods which may not translate well to actual practice.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• The data relies heavily on a student's subjective interpretation of their skills and competence within T&amp;O which may not correlate with objective measures.</li> <li>• The very nature of the event may be a confounding variable with students who lack competence in T&amp;O feeling potentially more obligated to attend in comparison to those who are more confident in their abilities. Therefore, the data may not be representative of the entire student population.</li> </ul>
Al-Nammari et al <sup>5</sup>	210 recently graduated medical students assessed using the Freedman and Bernstein MSK cognitive examination tool.	44 (21%) of students passed the assessment.	Inadequate competence in MSK medicine in graduates.	<p>Strengths:</p> <ul style="list-style-type: none"> <li>• Uses the Freedman and Bernstein MSK cognitive examination tool which is a validated tool with a predetermined cut-off.</li> <li>• Good sample size with graduates from a wide range of UK medical schools.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• Although the Freedman and Bernstein MSK cognitive examination tool is a validated tool, its contextual relevance is debatable with no data currently available on the correlation between competence as assessed by the Freedman and Bernstein test and patient outcomes.</li> </ul>
Jandial et al <sup>15</sup>	Anonymous questionnaire assessing self-rated confidence in paediatric MSK assessment was completed by 346 trainee doctors.	Paediatric MSK assessment was ranked as the least confident system in comparison to other bodily systems. Majority answered "no" or "some" (21% and 53% respectively) with regards to confidence in paediatric MSK assessment. In contrast most responded "confident" for cardiovascular, respiratory, and abdominal systems.	Poor undergraduate training in paediatric MSK medicine.	<p>Strengths:</p> <ul style="list-style-type: none"> <li>• Large sample size involving a wide range of different UK medical school graduates.</li> <li>• Includes trainees in a wide range of specialties (including orthopaedics).</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• Self-rated confidence is not a reliable indicator of MSK knowledge.</li> <li>• Respondents were qualified from 23 different medical schools, nine of which were not UK based. It is not clear how many of the respondents were UK graduates and if there was any discrepancy between UK and non-UK graduates.</li> </ul>

Atrey et al <sup>16</sup>	A questionnaire was devised and completed by 95 candidates including foundation year 1 and recently graduated medical students before and after an education programme.	<p>Prior to the education programme:</p> <ul style="list-style-type: none"> <li>• 35% of F1's trained at a district general hospital</li> <li>• 54% of F1's trained at a teaching hospital</li> <li>• 45% of the medical students attained the pass mark. Also, only 42% felt confident in being an on-call orthopaedic doctor. All these metrics improved following the education programme.</li> </ul>	Evidence of MSK knowledge deficiencies and low confidence in orthopaedic clinical practice in F1 doctors.	<p>Strengths:</p> <ul style="list-style-type: none"> <li>• Population includes both recently graduated and working F1 doctors which is helpful in assessing the effectiveness of foundation training in developing MSK knowledge. Furthermore, the sample size includes different hospital types which can help further assess discrepancies in knowledge/learning.</li> <li>• The study focused on practical, case-based scenarios akin to what junior doctors are likely to face in day-to-day orthopaedic practice. Therefore, it is more likely that the responses mirror clinical competence compared to other forms of assessment which do not relate as well to clinical practice.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• The population size is limited and includes graduates from a limited number of medical schools.</li> <li>• The testing process was validated by consultant orthopaedic surgeons and not by professional examiners/educators. It is therefore difficult to ascertain the validity of the questions used to assess knowledge.</li> </ul>
Basu et al <sup>17</sup>	Computer-based assessment covering core topics set at pre-registration house officer level in MSK medicine, cardiovascular medicine and neurology completed by 74 final year students at Sheffield Medical School.	A one-way analysis of variance revealed no significant difference in performance between the three fields.	MSK knowledge is equivalent to that of other disciplines despite less emphasis in the curriculum.	<p>Strengths:</p> <ul style="list-style-type: none"> <li>• Topics used for the assessment were derived from guidelines by well-established sources e.g. EULAR.</li> <li>• The questions were set at a reasonable standard for the students involved and the average item difficulty between systems was equitable.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• The sample size is limited and only includes Sheffield medical students.</li> <li>• The assessment only included 24 questions per system and so may not be representative of medical students MSK knowledge as a whole.</li> </ul>

<p>Basu et al<sup>18</sup></p>	<p>136 students from all years of study at Sheffield university completed a 40 multiple-choice progress test standardised by six MSK practitioners using a modified Angoff procedure.</p>	<p>Mean scores of students increased between first and final year from 41% to 84% and all final year participants score above the predicted standard.</p>	<p>Adequate competence in MSK medicine in final year students.</p>	<p>Strengths:</p> <ul style="list-style-type: none"> <li>• Involves medical students from all years of study which can help discern MSK knowledge progression.</li> <li>• Good sample size.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• The progress test they used is not a validated assessment tool. It uses Angoff/modified Angoff procedure. which does not use exam data to quantify a standard and is reliant on subjective interpretation by the MSK practitioners thereby negatively impacting the studies reliability and representativeness.</li> <li>• All participants were from Sheffield university and so may not accurately depict MSK knowledge of all UK medical students.</li> </ul>
<p>Spielmann et al<sup>19</sup></p>	<p>Participants (25 medical students, 15 pre-registration house officers and 10 senior house officers) were given five minutes to label all eight of the carpal bones on a diagram.</p>	<p>Only 15 participants (30%) were able to correctly label all eight carpal bones. The majority of medical students (68%) identified less than five.</p>	<p>Inadequate undergraduate teaching in MSK anatomy. However, these deficiencies may resolve during postgraduate training.</p>	<p>Strengths:</p> <ul style="list-style-type: none"> <li>• The inclusion of participants at different levels of training enables us to view postgraduate training has on MSK knowledge.</li> <li>• The method used is an objective measure of anatomical knowledge.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• The sample size is small and only includes 25 medical students from Edinburgh medical school.</li> <li>• Although the method is objective, it is a limited representation of MSK knowledge and so cannot be generalised to the subject as a whole.</li> </ul>