

Association between Orthopaedic In-Training Examination Subsection Scores and ABOS Part I Examination Performance

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Objectives: The Orthopaedic In-Training Examination (OITE) is administered yearly to assess a resident's progression, compare his or her performance with that of other residents, and evaluate the educational structure of a residency program. The American Board of Orthopaedic Surgery (ABOS) Part I examination is used to ensure competence in orthopedic knowledge and must be passed to achieve certification. Previous studies have correlated OITE and ABOS performance, but analysis between OITE subsection performance and ABOS Part I examination performance has not been reported. The purpose of this study was to evaluate the relation between individual OITE subsection performance and overall ABOS Part I performance.

Methods: Performance on the 12 subsections comprising the OITE from 1999 to 2009 was evaluated and compared with overall ABOS Part I examination performance. Spearman correlation coefficients (SCCs) were used to quantify the association between OITE subsection and overall ABOS percentile ranks.

Results: The OITE subsections of musculoskeletal trauma (SCC 0.29; $P = 0.0002$), hip and knee reconstruction (SCC 0.21; $P = 0.0064$), spine (SCC 0.16; $P = 0.04$), orthopedic science (SCC 0.17; $P = 0.03$), and orthopedic disease (SCC 0.18; $P = 0.02$) correlated with ABOS percentile ranks. Five of the top seven subsections by question volume on the OITE were found to correlate with ABOS performance.

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Conclusions: OITE subsections with greater representation and breadth of subject matter had stronger performance correlations with ABOS Part I examination performance. These findings may allow residency training programs to better predict ABOS Part I performance of their residents by evaluating particular subsections on the OITE in addition to overall OITE performance.

Key Words: American Board of Orthopaedic Surgery, knowledge, Orthopaedic In-Training Examination, resident training

The Orthopaedic In-Training Examination (OITE) is produced and administered by the American Academy of Orthopaedic Surgeons (AAOS). The OITE is a multiple-choice examination that is taken once each year throughout residency. The test is used by programs to gauge a resident's current orthopedic knowledge in relation to other residents, monitor a resident's progression during his or her residency, and evaluate the strengths and weaknesses of the residency program's educational structure. The Part I examination, which is overseen by the American Board of Orthopaedic Surgery (ABOS), is the orthopedic certifying examination. The scope of the test includes the entire field of orthopedic surgery. This certifying examination is used to help ensure the competence of orthopedic surgeons.¹

There are some notable differences between the examinations. The ABOS Part I examination is a test with higher stakes than the OITE. A certain passing score is set by the ABOS, above which examinees must achieve to obtain

Key Points

- Performance on the Orthopaedic In-Training Examination (OITE) subsections with a greater volume of questions and breadth of subject matter may help predict American Board of Orthopaedic Surgery Part I examination performance.
- Residency programs may identify those residents at risk for poor performance on the American Board of Orthopaedic Surgery Part I examination by reviewing certain OITE subsection scores in addition to overall OITE scores.

certification. In contrast, the OITE does not have a passing score; rather, it is used to assess progression and serves as a tool to compare residents with one another. In addition, the ABOS Part I examination is administered under highly secure testing conditions, whereas the OITE is administered by residency programs in variable testing settings without uniform policies.²⁻⁴

Despite differences between these examinations, OITE performance does predict ABOS Part I performance. Numerous studies have correlated the performance between these two examinations.^{1,5-8} Swanson et al⁸ studied the results of more than 3000 examinees and demonstrated strong correlations between OITE and ABOS performance, most notably during years 3 and 4 of residency training. Residents scoring below the 10th percentile on the OITE were much more likely to fail ABOS Part I when compared with those scoring above the 50th percentile on the OITE. The results from this study also demonstrated consistent increases in mean OITE scores as residents advanced in their training. Klein et al⁷ showed a high risk of ABOS Part I failure (63%) when residents scored below the 29th percentile on the OITE during year 3 of training or below the 20th percentile during year 5 of training. Conversely, residents scoring above the 32nd percentile during year 3 of training and above the 27th percentile during year 4 had no ABOS Part I examination failures. Dougherty et al⁵ noted a stepwise increase in correlation of OITE percentile rank from training years 2 through 5 with ABOS Part I percentile rank.

In 1997, the number of subsections on the OITE increased from 4 to 12. The names of the subsections before and after this change are shown in Table 1. Although a consistent relation between OITE and ABOS percentile ranks has been demonstrated, no analysis has been performed comparing OITE subsection performance with ABOS Part I examination performance.

The primary purpose of this study was to evaluate the relation between performance on individual OITE subsections

and overall ABOS Part I performance. Our hypothesis was that OITE subsections with a greater number of questions would have a stronger correlation with ABOS performance when compared with other subsections. In addition, this study aimed to quantify the representation of each subsection on the OITE by question volume.

Methods

Following institutional review board approval from our institution, we retrospectively reviewed OITE data obtained from the AAOS during an 11-year period (1999–2009) in a single orthopedic residency training program. Incomplete records prevented years 1997 and 1998 from being included. All of the data were deidentified. During the study period, the examinees took the test individually and without access to reference materials during the test. The residency training program was accredited by the Accreditation Council for Graduate Medical Education throughout the study period.

The OITE subsection percentile rank scores were collected for each year in training, and only residents with at least four OITEs were included. Year 1 of residency training refers to postgraduate year 1. The orthopedic residency training program in the present study is a 5-year program. The 12 OITE subsection percentile ranks and the overall percentile rank for each year in training were evaluated. Only the relative percentile ranks and not absolute raw scores were used, because absolute raw scores would be affected by test difficulty and the percentile rank scores would account for variations in difficulty.

The number of questions from each subsection of the OITE also was recorded for each examination year and combined to calculate the representation of each subsection by question volume during the years studied.

ABOS Part I examination performance data were obtained from the ABOS and also deidentified. The ABOS did not release any subsection performance data. ABOS Part I performance was defined by percentile rank. The Spearman correlation coefficient (SCC) was used to quantify the association between OITE subsection and ABOS Part I performance. Two-sided $P < 0.05$ was considered statistically significant.

Results

The total number of residents during the 11-year study period was 42; however, only 36 residents had at least 4 years of OITE scores, and this group formed the basis of the analysis. There were no ABOS Part I examination failures during this 11-year period.

The OITE subsection representation was as follows: trauma 19% (255 questions), pediatrics 13% (175 questions), orthopedic science 12% (162 questions), hip and knee reconstruction 8% (115 questions), orthopedic disease 8% (109 questions), sports medicine 8% (105 questions), spine 7% (94 questions), foot and ankle 7% (88 questions), hand 6% (82 questions), shoulder and elbow 6% (81 questions), rehabilitation 4% (49 questions), and medically related issues 3% (38 questions) (Fig.).

Table 1. Names and numbers of subsections on the OITE before and after 1997

OITE subsections before 1997	OITE subsections, 1997–present day
Adult Orthopedics	Pediatrics
Children's Orthopedics	Medically Related Issues
Orthopedic Science	Trauma
Musculoskeletal Trauma	Rehabilitation
	Hand
	Hip and Knee Reconstruction
	Spine
	Foot and Ankle
	Sports Medicine
	Shoulder and Elbow
	Orthopedic Science
	Orthopedic Disease

OITE, Orthopaedic In-Training Examination.

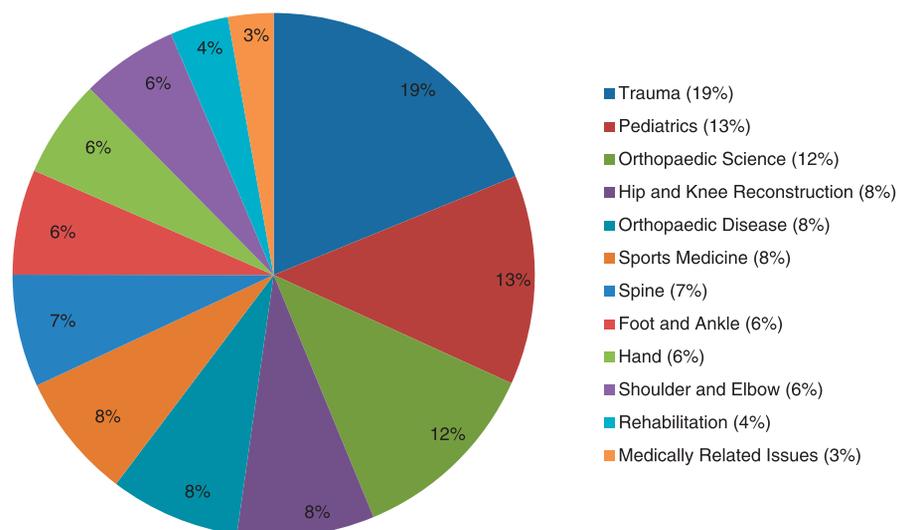


Fig. Breakdown of the Orthopaedic In-Training Examination composition by subsection question volume.

Subsection analysis demonstrated that trauma (SCC 0.29; $P = 0.0002$), hip and knee reconstruction (SCC 0.21; $P = 0.0064$), spine (SCC 0.16; $P = 0.04$), orthopedic science (SCC 0.17; $P = 0.03$) and orthopedic disease (SCC 0.18; $P = 0.02$) significantly correlated with ABOS Part I performance. During year in training 1, the subsection of spine (SCC 0.50; $P < 0.008$) had a significant correlation. During year in training 2, the orthopedic disease subsection demonstrated a significant correlation (SCC 0.36; $P < 0.03$). The number of individual subsections with a significant correlation with ABOS Part I performance increased years 3 through 5 of training. During year 3 of residency training, the subsections of trauma (SCC 0.60; $P < 0.0001$), hip and knee reconstruction (SCC 0.37; $P < 0.03$), and foot and ankle (SCC 0.46; $P < 0.005$) showed significant associations. During year 4 of training, the subsections of trauma (SCC 0.41; $P < 0.01$), hip and knee reconstruction (SCC 0.40; $P < 0.02$), and pediatrics (SCC 0.49; $P < 0.002$) were significantly correlated. In year 5 of training, the subsections of trauma (SCC 0.52; $P < 0.001$), rehabilitation (SCC 0.37; $P < 0.03$), and sports medicine (SCC 0.42; $P < 0.01$) showed significant correlations. The subsection with the greatest number of year in training groups showing a significant correlation was trauma with three, followed by hip and knee reconstruction with two. Several subsections never demonstrated a significant correlation, including medically related issues, hand, and shoulder and elbow. In addition, it was noted that for years 2 through 5 of residency training, the composite percentile rank on the OITE correlated well with ABOS Part 1 percentile rank. SCCs for the individual subsections for years 3 through 5 and the SCCs for the composite OITE scores are found in Table 2.

Discussion

The OITE is a comprehensive test of orthopedic medical knowledge that can help programs assess a particular

resident's strengths, weaknesses, and progress during residency. Furthermore, it can help programs prepare their residents for the ABOS Part I examination and identify residents who may be at risk for poor performance and thus possible failure on ABOS Part I. Several studies have examined individual subsections of the OITE, looking at frequency of topics within a subsection, taxonomy distribution, and types of sources referenced.⁹⁻¹⁴ The importance of these studies has been to encourage examinees and faculty involved in resident education to better understand and prepare for the topics and

Table 2. OITE subsection score correlation with ABOS Part I performance

Subsection	Aggregate of years 1-5	Year 3	Year 4	Year 5
Pediatrics	0.14	0.18	0.49	0.21
Medically Related Issues	0.08	0.07	0.27	-0.07
Trauma	0.29	0.60	0.41	0.52
Rehabilitation	0.02	-0.09	-0.16	0.37
Hand	0.15	0.11	0.12	0.23
Hip and Knee Reconstruction	0.21	0.37	0.40	0.09
Spine	0.16	0.12	0.20	0.08
Foot and Ankle	0.06	0.46	0.05	0.04
Sports Medicine	0.10	0.21	-0.04	0.42
Shoulder and Elbow	0.03	0.21	0.03	0.12
Orthopedic Science	0.17	0.28	0.11	0.11
Orthopedic Disease	0.18	0.17	0.15	0.25
Composite OITE score	0.22	0.43	0.40	0.42

Numbers in bold are statistically significant. ABOS, American Board of Orthopaedic Surgery; OITE, Orthopaedic In-Training Examination.

types of questions encountered on the various subsections of the OITE. To our knowledge, however, no study has analyzed the correlation between performance on individual subsections of the OITE with overall performance on the ABOS Part I examination.

Our study has several limitations. Foremost, the number of OITE examinations and residents was limited. A larger sample size may have shown significant correlations for other subsections of the OITE. In addition, all of the examination scores analyzed were from a single residency training program, which limits extrapolation to other orthopedic training programs. These issues may be addressed with multicenter evaluations. Also, there were no failures during the time period studied on the ABOS Part I examination, limiting conclusions about predicting failure by OITE subsection analysis.

We acknowledge that ABOS Part I examination performance is ultimately a binary result: pass or fail. A higher percentile rank does not necessarily hold significance for those simply seeking certification. One can assume, however, that residency graduates obtaining a higher ABOS Part I examination percentile rank were at lower risk of failure. As such, it is important to identify predictors of ABOS Part I performance, one of which is OITE subsection performance.

Trauma is the largest subsection on the OITE, responsible for nearly 20% of all test questions. In general, orthopedic trauma questions address multiple anatomic areas and numerous principles that conceivably cover a wider scope of orthopedic knowledge than other subsections. Moreover, during orthopedic residency the greatest allotment of time is generally directed to trauma and fracture care¹⁵; therefore, our finding that performance on the trauma subsection of the OITE correlated well with ABOS performance was expected. The observation that multiple other subsections had no correlation with ABOS performance is not easily explained, however. These subsections tended to have a smaller percentage of questions overall and conceivably may test a more narrow breadth of orthopedic knowledge. Surprisingly, however, the pediatrics subsection, which was the second most represented subsection by percentage of questions on the OITE, did not correlate well with ABOS Part I percentile rank. Otherwise, performance on five of the top seven subsections on the OITE by question volume was found to correlate significantly with ABOS Part I percentile rank. Individual subsection analysis from the ABOS Part I examination is not provided to residency programs, preventing comparison between OITE subsections and their corresponding ABOS subsections. Potential differences may account for why certain subsections on the OITE did not predict overall ABOS Part I performance.

The concept of educational taxonomy has been investigated and may provide an explanation for why different OITE subsections did or did not correlate with overall ABOS Part I performance. Based on the cognitive processes required to answer a specific question, the AAOS has categorized the questions on the OITE into three taxonomic levels: recall or

recognition, interpretation, and problem solving.¹⁶ Papp et al¹¹ examined the taxonomy of the pediatrics subsection on the OITE from 2002 to 2006 and determined that 42% of questions were level 1, 12% were level 2, and 46% were level 3. Seybold et al¹² analyzed the trauma section of the OITE and found that from 2004 to 2008, 51% of questions were level 1, 11% were level 2, and 38% were 3. Such taxonomy distribution differences across each subsection may account for the lack of correlation between performance on certain subsections of the OITE and overall ABOS Part I performance. A detailed analysis of subsection taxonomy during the study period may provide additional insights into which taxonomy question type best correlates with ABOS Part I performance.

Conclusions

The foundation of both the OITE and the ABOS Part I examination is orthopedic knowledge. We demonstrated that subsections represented by a greater percentage of questions on the OITE in general correlate better with ABOS Part I performance. Areas with greater representation on the OITE included trauma, hip and knee reconstruction, spine, orthopedic science, and orthopedic disease, and these subsections were specifically shown to correlate well. These findings may allow residency training programs to identify more quickly residents at risk for poor performance on the ABOS Part I examination by evaluating particular subsections on the OITE in addition to overall OITE performance. Also, the percentage representation of OITE questions by subsection found in the Figure may help residencies balance the program's educational lecture schedules to reflect this distribution. Ultimately, these findings may assist faculty and residents in better tailoring education to improve performance on these examinations.

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