in the literature in recent years to increase homogeneity in identifying patients with ankle injuries, and I commend the authors for their use of this instrument. However, the FAI group in this study had better self-reported function on the FADI than did the MAI group and was not different from the coper group. This suggests that the MAI group and not the FAI group possessed a functional limitation.

Therefore, these 2 measures of participant identification indicate that the MAI group had more functional limitation than the FAI group and the coper group, and the FAI group might not have had functional limitation compared with the coper group. From the results of the identified measures of interest in the study, hip kinematics and ground reaction forces, the MAI group had a diminished level of functional performance, whereas the FAI group did not differ from the coper group. This finding further supports the possibility that functional limitation might have been present in the MAI group and not in the FAI group.

The authors did well to include a novel design that attempted to separate the MAI, FAI, and coper groups rather than only comparing those with CAI and healthy control participants, as is seen in the majority of this literature. Unfortunately, these authors may have misinterpreted or incorrectly applied the inclusion criteria they were attempting to use. Nonetheless, the finding that a group of patients with a history of ankle injury who self-reported functional limitations and presented with greater ankle laxity (MAI group) displayed differences in hip kinematics and ground reaction force compared with a group of copers is quite novel and has interesting implications for clinicians and researchers. In some ways, the MAI group may embody what the CAI definition is designed to exemplify: a condition that includes both mechanical and functional limitations. Future researchers should build on this study to address these limitations and what they mean for clinical management and improvement of chronic ankle injuries. This information should lead to improved interpretation of the criteria being applied, allowing development of the most appropriate set of criteria to shape consistency in the literature.

REFERENCES

1. Hertel J. Functional anatomy, pathomechanics, and pathophysiology of lateral ankle instability. *J Athl Train*. 2002;37(4):364–375.
2. Hertel J. The complex etiology of lateral ankle instability. *J Orthop Sports Phys Ther.* 2005;35(5):A9–A10.
3. Cohen J. *Statistical Power Analysis for Behavioral Sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.

Address correspondence to Phillip A. Gribble, PhD, ATC, Mailstop #119, Department of Kinesiology, University of Toledo, Toledo, OH 43606. Address e-mail to phillip.gribble@utoledo.edu.

Authors' Reply

We thank Dr Gribble for offering commentary on our article and the editors of the *Journal of Athletic Training* for the opportunity to respond. The reviewer has provided interesting and valuable insight into the difficulties of classifying and rating clinical conditions in ankle instability.

We fully agree with the reviewer that Hertel[1] suggested that chronic ankle instability (CAI) "may be caused by mechanical instability, functional instability, or a combination of these entities." Hertel[1] also stated, "While the dichotomy of functional and mechanical instability helps explain 2 common potential causes of CAI, it does not adequately reflect the complete spectrum of pathologic conditions to CAI," and "Specific insufficiencies interact to create either mechanical instability or functional instability." We support Gribble's and Hertel's statements that functional ankle instability (FAI) and mechanical ankle instability (MAI) probably combine to create the condition of persistent rolling, spraining, and giving way at the ankle. We have attempted not to focus solely on one construct or the other. Rather, we selected a group that displayed symptoms of CAI, some of whom also displayed obvious mechanical laxity, and compared them with people with CAI and less obvious mechanical laxity (FAI group). We took this approach as a first step toward Hertel's[1] recommendation to further elucidate the interactions among mechanical and functional insufficiency and the relationships between specific insufficiencies. As a point of clarification, we did not state that the MAI group had no evidence of FAI; indeed, they met the same inclusion criteria as the FAI group for entry into the study with regard to minimum injury history and self-reported episodes of giving way. However, they exhibited the additional component of mechanical laxity and, therefore, may be considered further along the continuum or spectrum of instability and thus more symptomatic than the FAI group, as Gribble argues.

A recent review by Delahunt et al[2] illustrated the difficulty researchers have in categorizing and classifying people with CAI, as evidenced by the great variety of inclusion and exclusion criteria. We think that our common inclusion criteria for the MAI and FAI groups match the same basic criteria as did the groups studied by the majority of the investigations outlined in the publication. We simply added an additional criterion of clinically obvious physiologic laxity to one subgroup.

Gribble highlights our use of the coper group, as suggested by Hertel and Kaminski.[3] We agree that this is a more relevant clinical comparison group, given the same injury exposure. Because it is a recent recommendation, few other authors have included this group, and the inclusion and exclusion criteria are not clearly defined for the research community. It is likely that the coper group fell along the continuum of instability, with fewer deficits than the MAI and FAI groups, but some overlap in their distributions was indeed possible.

We used self-reported episodes of giving way and scores on the Foot and Ankle Disability Index (FADI) and FADI-Sport subscale to describe functional limitations in our participants, not to define group inclusion and exclusion criteria. Gribble is correct in stating that the MAI group self-reported more episodes of giving way and lower FADI and FADI-Sport subscale scores, which indicated greater functional deficits. No cutoff scores were used for group inclusion criteria on the FADI or FADI-S because evidence for such scores is limited, and only recommendations exist.[4] Gribble is also correct that we did

not include self-reported episodes of giving way in the coper group, which could provide valuable comparison information. However, we take issue with his assertions that the participants in the FAI group did not have functional limitations at their ankle. The coper group's mean self-reported total number of episodes of giving way was 1.9 ± 0.6. The MAI and FAI groups were not different in the number of episodes of giving way, but both groups reported significantly more episodes of giving way than did the copers, indicating that the FAI group did have functional deficits in this measure.

We commend the reviewer for his use of effect sizes for comparisons, which are more clinically relevant than *P* values. The effect size for the MAI to FAI comparison for number of episodes of giving way was moderate, which may reflect more functional limitations in the MAI group than in the FAI group. However, the FAI to coper comparison effect size was 0.96, or large, indicating greater functional limitations in the FAI group than in the copers.

The reviewer also cites the fact that the MAI group reported lower scores on the FADI compared with the FAI group, demonstrating less function, but the FAI group score was not lower than that of the copers. This statement is accurate and indicates that the MAI group had greater functional limitations with more activities of daily living than did the FAI group, whereas the FAI and coper groups had similar functional levels with activities of daily living. However, the FAI group was not different from the MAI group on the FADI-Sport subscale and was lower than the coper group on the FADI-Sport subscale. Thus, both the MAI and FAI groups had greater functional deficits associated with sport-related, physically demanding tasks than did the coper group. The effect size for the FAI-coper comparison on the Sport subscale was 1.1, indicating a large difference in functional limitations. The Sport subscale focuses on more demanding physical tasks, such as the stop-jump maneuver in this protocol. The FADI and FADI-Sport are only moderately correlated and were reported to "measure different functional deficits."[5] As a result, we are not surprised that our instability groups had different scores on the different sections. Although our group mean scores were slightly higher than those reported in previous studies,[4,6,7] indicating better function, they were still lower than those of the copers, with effect sizes indicating clinically relevant differences. Therefore, when combining the number of self-reported episodes of giving way with the FADI-Sport scores, we think the FAI group did have functional limitations when compared with the coper group. The limitations might not have been as great as those of the MAI group, but they were present and significant.

Our study was conducted with the intention of making an initial contribution to elucidating the interactions between mechanical and functional insufficiencies and their contributions to the continuum of instability. We appreciate the reviewer's perspective and insight into the difficulty of classifying ankle instability and its contributing factors. He raises thoughtful and important questions about quantifying the degree of instability and functional deficits and how to objectively measure them for research group criteria. Ultimately, our study is only one step of many that are needed in order to determine the combined contributions of functional and mechanical deficiencies to CAI.

Cathleen N. Brown, PhD, ATC
University of Georgia, Athens
Darin A. Padua, PhD, ATC
Stephen W. Marshall, PhD
Kevin M. Guskiewicz, PhD, ATC, FNATA, FACSM
University of North Carolina at Chapel Hill

REFERENCES

1. Hertel J. Functional anatomy, pathomechanics, and pathophysiology of lateral ankle instability. *J Athl Train*. 2002;37(4):364–375.
2. Delahunt E, Coughlan GF, Caulfield B, Nightingale EJ, Lin CW, Hiller CE. Inclusion criteria when investigating insufficiencies in chronic ankle instability. *Med Sci Sports Exerc*. 2010;42(11):2106–2121.
3. Hertel J, Kaminski TW. Second International Ankle Symposium summary statement. *J Orthop Sports Phys Ther*. 2005;35(5):A2–A6.
4. McKeon PO, Ingersoll CD, Kerrigan DC, Saliba E, Bennett BC, Hertel J. Balance training improves function and postural control in those with chronic ankle instability. *Med Sci Sports Exerc*. 2008;40(10):1810–1819.
5. Hale SA, Hertel J. Reliability and sensitivity of the Foot and Ankle Disability Index in subjects with chronic ankle instability. *J Athl Train*. 2005;40(1):35–40.
6. Hale SA, Hertel J, Olmsted-Kramer LC. The effect of a 4-week comprehensive rehabilitation program on postural control and lower extremity function in individuals with chronic ankle instability. *J Orthop Sports Phys Ther*. 2007;37(6):303–311.
7. Hubbard TJ, Cordova M. Mechanical instability after an acute lateral ankle sprain. *Arch Phys Med Rehabil*. 2009;90(7):1142–1146.