Training

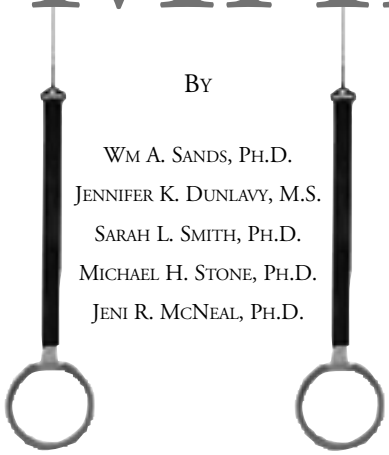
Jonathan Horton at
The 2006 Winter Cup
Championships.

ABOVE PHOTO BY STEVE LANGE

Understanding and THE MALTESE

By

Wm A. Sands, Ph.D.
Jennifer K. Dunlavy, M.S.
Sarah L. Smith, Ph.D.
Michael H. Stone, Ph.D.
Jeni R. McNeal, Ph.D.

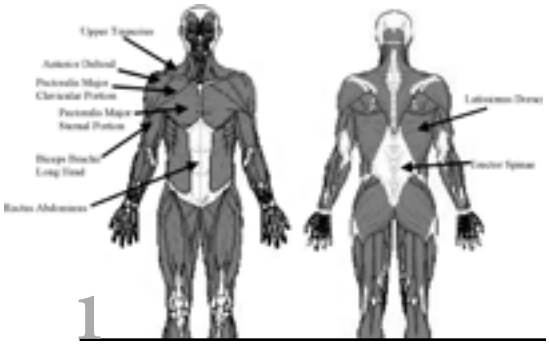


THE MALTESE CROSS IS AN EXTREMELY difficult strength-oriented skill performed by the best gymnasts on the still rings. The current *Code of Points* rates the Maltese with a high degree of difficulty resulting in a natural pursuit of the skill for those seeking a competitive advantage. The competitive value and the extreme difficulty of the skill places a considerable burden on the athlete's time and the coach's skill. Should an athlete attempt to learn this skill? Would training time be better placed pursuing a different skill? Can the coach determine whether the athlete is particularly close to performing the skill and thus confidently pursue the skill with assurance that the training time will be well spent? There are a number of drills that can be used to help the gymnast learn the Maltese; are some drills better than others? All of these questions plague the modern coach and athlete. Training time is limited and intelligent choices are not always obvious.

The purpose of this project was to outline two different approaches taken by the U.S. Men's National Team and Coaches to increase their understanding of the Maltese. The first approach incorporated the use of electromyography (EMG, Noraxon, Inc.) to ascertain which muscles are involved and most active in performing this skill and several learning drills. The second approach involved the use of small force platforms to determine if measuring the forces applied by both arms in a simulated Maltese position could determine whether an athlete was capable of performing a Maltese, how close an athlete might be to performing the skill, and symmetry of arm forces.

MUSCLE ACTIVATION

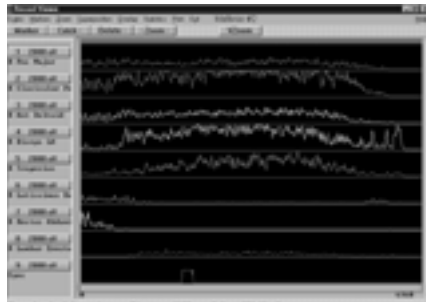
A kinesiological (study of motion) analysis and coaching input suggested the following muscles might be large contributors to the Maltese: sternal portion of the pectoralis major, clavicular portion of the pectoralis major, anterior deltoid, long head of the biceps brachii, upper trapezius, latissimus dorsei, rectus abdominus, and the lumbar portion of the erector spinae.



1


2


3


4

1) Anatomical images showing the muscles assessed by EMG. **2)** Athlete with EMG electrodes attached for evaluation of the Maltese. **3)** Maltese on the low rings with a spot. **4)** Computer screen showing the EMG signals indicating the level of muscle activations of a gymnast performing a Maltese. The lowest horizontal line (Sync) is a synchronization signal that involved a coach pressing a button to indicate when the gymnast was in the correct position for the Maltese.

Figure 1 shows the muscles that were investigated.

Figure 2 shows the application and placement of surface electrodes used to determine the activation level of muscles during the Maltese. Muscle activation is detected by the surface electrodes, and the signals are then transmitted by a small transmitter in a belt pack to a receiver and computer. The transmitter allows the athlete to move without being encumbered by cables.

Figure 3 shows a typical method used by coaches to help athletes learn to perform the Maltese–spotting. This study found that although spotting in this manner was fairly close to an actual Maltese in terms of muscle activation, the upper trapezius muscle activity was much lower than expected. This may have been due to the reduced need for the athlete to balance himself and thus control his body position within the rings. More than 20 drills were assessed regarding their similarities to the actual Maltese. The best drills for the Maltese are shown in Figures 5-8.

Figure 4 shows the results of the muscle activation profile of an athlete performing a Maltese. Each horizontal "squiggly" line shows the electrical activity that was being produced by the underlying muscle. The muscles are labeled on the left. Note that the higher the "squiggly" lines the more activity that is being shown by the muscle.

The EMG analysis showed that the primary muscles involved in the Maltese were, in order of importance: clavicular pectoralis major, biceps brachii long head, anterior deltoid, upper trapezius, sternal pectoralis major. Muscles providing little or no contribution included: latissimus dorsei, rectus abdominus, and erector spinae. A total of five athletes were assessed via EMG to determine muscle contributions when performing the Maltese. The outcomes of the EMG profiles were virtually identical for all five gymnasts. The conclusion reached from these analyses was that the primary muscle involvements were upper shoulder muscles. Moreover, it was also shown that having the athlete in a correct horizontal position was crucial to eliciting the correct muscle involvement. When an athlete adopted a position in which the head and shoulders were too high, the muscle activation pattern changed dramatically and no longer showed the typical profile of a Maltese.

A cautionary note should be included at this point. Although the EMG analyses indicated which muscles were most active in the Maltese and associated drills (of the muscles selected), the EMG cannot provide a measurement of the actual magnitude of the forces. From experience and knowledge of the difficulty of the Maltese it can probably be assumed that the most active muscles were quite close if not at their maximums; however, the magnitudes of the actual forces that these muscles generate during the Maltese are unknown. Therefore, it is important to understand the difference between muscle activation relative to force produced and muscle activation as part of an intact skill. In other words, there is more to performing a "skill" than just producing appropriate forces. The forces have to be timed, coordinated, and directed effectively. Here are some caveats to be aware of:

1. A gymnast might be able to produce a similar muscle activation pattern in a Maltese drill as in a real Maltese, but the gymnast's muscles cannot produce the amount of force necessary to actually perform the Maltese. Thus, the EMG pattern could be identical, but the gymnast still can't perform the skill.
2. A strong individual muscle might be able to produce more than enough force for that individual muscle to perform its role in a Maltese. However, the Maltese requires a carefully orchestrated combination of forces provided or generated by a number of muscles.
3. There were some assumptions made regarding the muscles chosen for assessment. If these assumptions are incorrect, then the wrong muscles were measured and there may be some other muscles that are more crucial to the Maltese performance than those assessed here.

The use of boxes (like the box shown in Figure 8) supporting the entire arm of the gymnast as he raises and lowers through the Maltese position, low rings with a spotter, and the "dream machine" were next in their ability to simulate the Maltese muscle activation. However, these all showed deficiencies when compared to the drills shown in Figures 5-8.

CREATING THE FORCE TO PERFORM A MALTESE

In a second experiment, a newly designed instrumentation system was used to measure the level of force produced by a gymnast during a simulated Maltese. The investigation was conducted during the joint USA–Japan training camp held at the Olympic Training Center in Colorado Springs. The basic approach is shown in Figure 9. A gymnast lies in a prone position with the

palms of his hands in the center of two small force platforms (PASCO, Inc). The forces produced by each hand/arm are sampled and recorded as the gymnast attempts to rise a few centimeters from the floor. Figure 10 shows an example of a force-time record produced by a gymnast who could perform the Maltese. The total force is simply the sum of the two hands/arms forces. If the gymnast can produce more force than his body weight, also shown in Figure 10, then he should rise from the floor and thus be able to perform the Maltese. This investigation was able to distinguish between those gymnasts who could perform a Maltese from those who could not. Additionally, the approach showed any asymmetries (differences from left side to right side) with startling graphic simplicity.

The results of the Maltese testing protocol can be used to determine how close a novice gymnast is to performing the Maltese. Also, the gymnast's strength symmetry can be determined along with a potential window on fatigue. Strength symmetry assessments may help diagnose shoulder injury. It was also noted that fatigue might be detected when gymnasts are not able to produce as much force on one occasion as they did on another.

CONCLUSION

The men's gymnastics team graciously allowed these tests to help understand the Maltese. Muscle activation patterns and a variety of learning drills have been identified. A promising test is being explored and a means for monitoring progress in the Maltese have also been identified. In the future, other still rings strength skills need to be tested and these methodologies applied to the study of shoulder injury.

Wm A. Sands, Ph.D.
Head – Sport Biomechanics and Engineering
U.S. Olympic Committee

Jennifer K. Dunlavy, M.S., Intern
Sport Biomechanics and Engineering
U.S. Olympic Committee

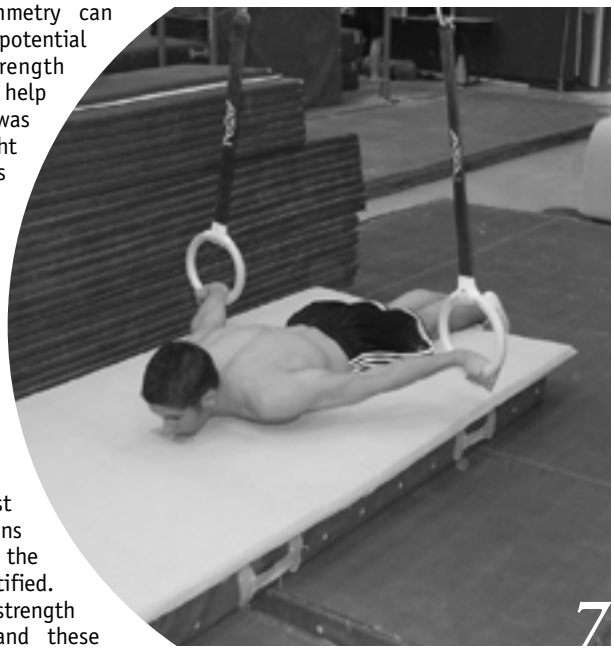
Sarah L. Smith, Ph.D.
Sport Biomechanics and Engineering
U.S. Olympic Committee

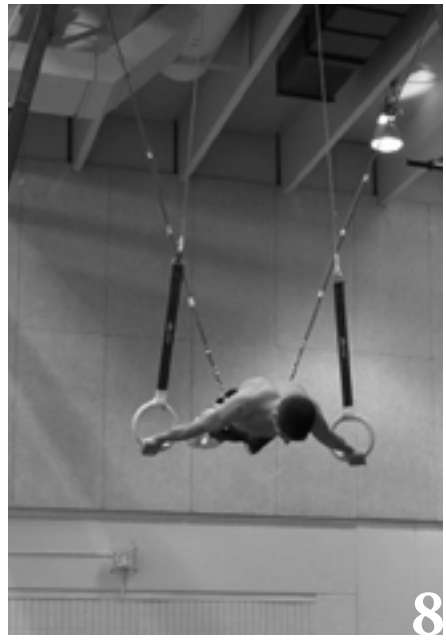
Michael H. Stone, Ph.D.
Exercise and Sport Science
Laboratory Director
East Tennessee State University,
Johnson City, TN

Jeni R. McNeal, Ph.D.
Associate Professor
Eastern Washington University, Cheney WA

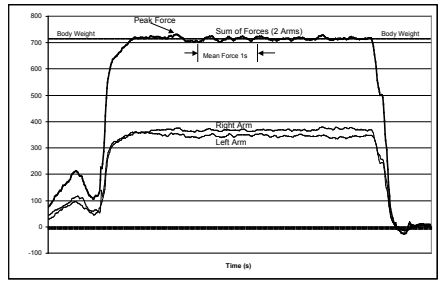

5


6


7


8


9



10

5) Attempting a Maltese position on two physio-balls. *Note that the coach is protecting the gymnast and spotting him while he lowers himself forward toward the Maltese position.* **6)** Cable Pulls. The athlete sets a resistance that is quite heavy and pulls the cables to a Maltese position. **7)** Lowering through a Maltese position on the floor via floor level rings. **8)** Weighted Counterbalance. The gymnast uses a spotting belt with attachment to a counterweight. The counterweight should be only sufficient to hold the gymnast's weight for a few seconds. **9)** Maltese Force Test Position. The gymnast is lying in a prone position with hands on the two small force platforms. The data logger that records the data is shown as the small instrument (looks like a large calculator) on the floor near the head of the gymnast. To perform the test, the gymnast presses with his hands/arms attempting to raise the entire body off the floor a few centimeters. **10)** Force-Time Curve of a Maltese Test. Note that the sum of the gymnast's hand/arm forces rises to that of body weight. This shows what was in fact observed–the gymnast's body was raised a few centimeters above the floor.