Sports Med. 1996 Jul; 22 (1): 19-37
0112-1642/96/0007-0019/$09.50/0



# The Use of Isometric Tests of Muscular Function in Athletic Assessment

*Greg J. Wilson*[1] and *Aron J. Murphy*[2]

1 The Centre For Exercise Science & Sport Management, Southern Cross University, Lismore, New South Wales, Australia

2 School of Human Movement, Physical Education and Recreation, Deakin University, Melbourne, Victoria, Australia

## Contents



## Summary

Isometric assessment of muscular function is a popular form of testing which has been used in exercise science for over 40 years. It typically involves a maximal voluntary contraction performed at a specified joint angle against an unyielding resistance which is in series with a strain gauge, cable tensiometer, force platform or similar device whose transducer measures the applied force. Often both the maximum force and the rate of force development are recorded. These tests have generally shown high reliability in both single and multi-joint test protocols, although the maximum force is typically more reliable than rate of force development. This review outlines the reliability of isometric assessment and discusses a number of methodological considerations designed to enhance

reliability and validity, including standardisation procedures, type of instructions, muscular pre-tension, testing position and joint angle.

Currently, there appears to be considerable controversy as to the external validity of isometric assessment, particularly the ability of the tests to monitor changes in dynamic performance and their relationship to such performances. Indeed, a number of studies have recently shown that dynamic assessment modalities (isokinetic and isoinertial) are superior in terms of their relationship to dynamic performance and ability to discriminate between athletes of various performance levels compared with isometric assessment.

This article reviews the use of isometric assessment in exercise science and consequently outlines a number of neural, mechanical and methodological factors which may have contributed to the contrasting research, and which may limit the ability of isometric assessment to relate to dynamic movement. Because of the large neural and mechanical differences between isometric and dynamic muscular actions, athletic assessment, which is dynamic in its nature, is generally most appropriately accomplished using dynamic muscular assessment methods, and in most instances isometric testing should be avoided.

## 1. Background to Isometric Assessment

Isometric assessment of muscular function is a widely employed testing modality which has been popular for a number of years, and still enjoys considerable support.[1-26] In a comprehensive review of the strength literature Atha[27] stated that 'Strength can be defined simply as the ability to develop force against an unyielding resistance in a single contraction of unrestricted duration'. This isometric definition of strength was recently endorsed by Enoka[28] who stated 'Muscle strength is defined as the magnitude of the torque exerted by a muscle or muscles in a single maximum isometric contraction of unrestricted duration'.

Clarke[8] developed one of the first detailed and standardised protocols for isometric assessment measuring total body strength. The test battery included 28 tests of isometric strength about the wrist, elbow, shoulder, hip, knee and ankle joints. The joint angle at which each test should be performed was also outlined, although the author did not offer a rationale as to why these angles were chosen. Since that time, the majority of isometric tests used in research have predominantly been single joint in nature, however in recent years, multi-joint testing protocols have gained in popularity.[10-12,14,17,21,23-26,29]

Isometric tests involve participants producing a maximal force or torque against an immovable resistance, which is in series with a strain gauge, cable tensiometer, force platform or similar device whose transducer measures the applied force. The tests are generally performed to quantify the maximal isometric force (or torque) and/or the maximal isometric rate of force (or torque) developed (RFD). The maximal RFD is typically quantified as the greatest slope of the force time curve. The time period over which the rate of change in force is determined has varied from an interval of 5 msec[25,30] through to 60 msec,[7] with most researchers tending to use a value towards the lower end of this range. In current work, we have found that increasing the time period from 5 through to 60 msec reduced the magnitude of the RFD, however, this increase did not appreciably affect its reliability nor validity. Other quantification methods include determining the time taken to reach a certain level of absolute force, such as 500N, or the time taken to a relative force level, such as 30% of maximum.[12,30] Alternatively, the force or impulse value in a specified time, such as 30 or 100 msec, has been used to quantify the RFD using an isometric test.[4,23,31]