

Vol 3, 2004 CEC ARTICLE

Exercise Analysis by C. D. Holcomb

A. Types of Contractions - Background

Dynamic Constant (isotonic)

- 1) The amount of resistive force encountered determines the amount of muscle force applied. More resistive force requires more muscle force. The water, compared to air, is twelve times more resistant. Adding gloves, hand bells, etc., increases the resistance.
- 2) The resistive force (water) remains constant throughout the exercise movement. However, the effective muscle force is higher in some positions and lower in other positions due to the mechanics of human movement. Free weights would also provide a dynamic constant resistance.

Dynamic Variable (isotonic)

- 1) The dynamic variable is the same as the dynamic constant, in that the amount of resistive force encountered determines the amount of muscle force applied. It is DIFFERENT than dynamic constant, in that the resistive force changes throughout the exercise movement. The use of dyna-bands, tubing, a weightstack machine with levers, cams, or linkage systems and specially designed air pressure equipment provides dynamic variable resistance.

Isokinetic Contractions

- 1) The joint is moving at a constant angular velocity, a constant movement speed, and a Matching resistive force.
- 2) The amount of muscle force applied determines the amount of resistive force encountered. More muscle force produces more resistive force. This type of contraction is only possible with isokinetic equipment such as hydraulic resistance machines and electronic resistance machines capable of varying the resistance and maintaining a constant angular velocity.

Isometric Contraction – Static

Isometric contractions are an important component in training the stabilizing muscles. An isometric contraction occurs when the resistance is an immovable object such as a wall or weight-training equipment, or the opposing muscle group. No visible movement occurs.

B. Objective Of Exercise Analysis

(Safety and Muscular Balance)

Our Responsibilities to Our Patrons Include

Proper exercise routines that do not aggravate existing conditions (carpal tunnel, lordosis, kyphosis, tendonitis, rotator cuff strains, or shoulder problems) or cause overuse injuries.

Be aware of injuries, Ask question about injuries, and Give options, Get Feed Back

Proper exercise routines that improve muscular balance, that reduce the risk of injuries, that help compensate for job related muscular imbalances, and that allow the patron to achieve a higher quality of life.

Sometimes it is beneficial to concentrate on exercises that combat muscle imbalances caused by modern life. i.e. more back, external rotators, traps and rhomboids.

C. Forces

How to Determine Where is the Force?

(Buoyancy, Resistance, and Gravity)

When using equipment in the Water Ask These Questions

Does the equipment float and requires significant force to push it underwater? (Buoys, noodles, balls, Kick boards, Cuffs, foam blocks)

If the answer is yes than buoyancy dominates motions that are up and down in the water. The force is always up. When moving side-to-side or front back, resistance dominates the motion and the force is always against the direction of the movement. **Remember isometric contractions are also important with buoyancy.**

Does the equipment sink and requires significant force to keep it up in the water? (Hand Weights, Leg Weights, Bricks)

If the answer is yes than gravity dominates motions that are up and down in the water. The force is always down. **Remember isometric contractions are also important with certain gravity-based exercises. IF there is side-to-side motion, resistance dominates.**

Is the equipment neutral with surface area? (Gloves, Fins, Frisbees, Paddles)

If the answer is yes than Resistance dominates motions in the water. The force is always against the direction of motion.

More Subtle Questions?

How does a flotation belt effect aqua exercises? **It doesn't change the muscles worked. Only less effort is required to stay afloat. The belt is attached to you. You do not have to exert effort to hold on to it.**

What is the main difference in muscle work between suspended (Level II) and deep-water exercises versus shallow water exercises? **Hip activation is important in the deep water, Ankle and Foot in the shallow. Have participants walk around the room normally first and then on their heels without pushing off with their toes. They should have to use the hip more to move the leg.**

What changes with bands, surgical tubing, and leashes? **Resistance in along the equipment towards the center and the force increase the more the equipment is stretched.**

What muscle groups are worked during pushups on the gutter? **Triceps and Isometric Trap III. Facing gutter Trap III, Triceps and Pec Minor Ecc. Con. Facing away Trap III, Triceps and Anterior Deltoid Ecc. Con. NO PEC MAJOR IN THIS EXERCISE.**

D. Analysis for Water

How to Determine Which Muscles are Primary Movers (Force versus Gravity)

Which muscles are primary movers and the type of contraction the muscle is undergoing depend of the Force, the Direction of the force, and the change in the muscle length. **Gravity is Down, Buoyancy is Up, and Resistance is Against the Direction of Movement**

Many people memorize which muscles are being worked by land based free weight exercises and their names where gravity acts on the weight. They forget when they change their orientation, environment, or equipment they change the type of force, the direction of the force, and whether the muscle is lengthening, shortening, or are an isometric. **IF you hold on to the sides of your chair and push down so you raise your butt of the chair, the TRAP III are isometrically holding you up like buoys in the water would.**

Example 1: Bicep Curl?

On land with weights

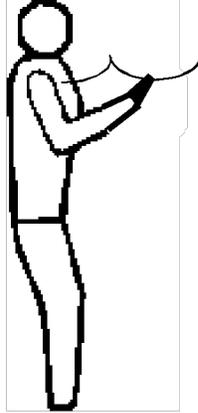
Force is gravity
Force is down
Bicep Eccentric
Bicep Concentric

In water with gloves

Force is resistance
Force is against direction of motion
Bicep Concentric
Tricep Concentric

In water with buoys

Force in buoyancy
Force is up
Tricep Eccentric
Tricep Concentric



Example 2: Pec fly?

On Back with Weight

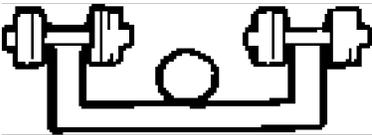
Force is gravity
 Force is down
 Pecs & triceps Eccentric
 Pecs & triceps Concentric

On Front with Weight

Force is gravity
 Force is down
 Traps & Biceps Eccentric
 Traps & Biceps Concentric

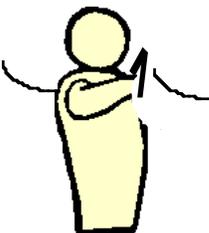
Standing Up with Weight

Force is gravity
 Force is down
 Medial Deltoid Isometric
 Tiny Pecs Concentric
 Tiny Trap II Concentric



Standing in Water With Gloves

Force is Resistance
 Force is against direction of motion
 Pecs Concentric
 Trap II Concentric



Standing in Water With Buoys

Force is Resistance & Buoyancy
 Force is against direction of motion and up
 Pecs Concentric
 Trap II Concentric
 Some Trap III Isometric



Suspended in Water With Buoys

Force is Buoyancy & Resistance
 Force is up and against direction of motion
 Trap III Isometric.
 Pecs Concentric
 Trap II Concentric



Example 3: Running?

On Land

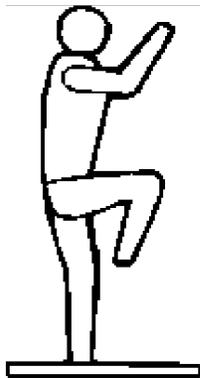
Force is gravity
 Force is down
 Illiopsosas Ecc.
 Soleus Concentric
 Soleus Concentric
 Gastroc. Concentric

In Shallow Water

Force is Resistance
 Force is against direction of motion
 Illiopsosas Con.
 Glut. Max Concentric
 Gastrocnemeius. Concentric
 Glut Max Concentric
 Hamstring Concentric

In Deep Water w/Belt

Force is Resistance
 Force is against direction of motion
 Illiopsosas Concentric Illiopsosas. Concentric
 Hamstring Concentric

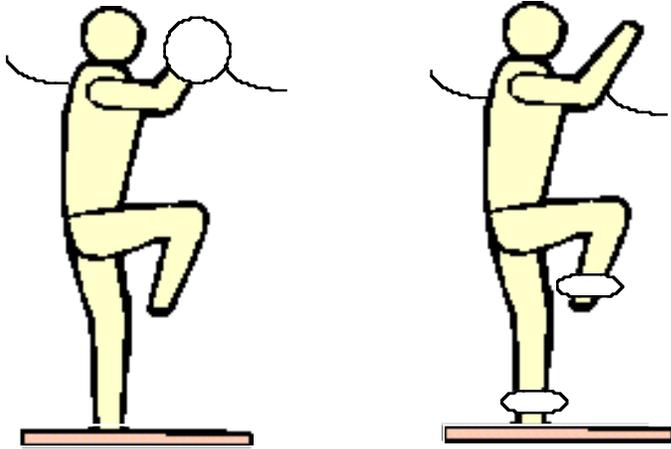


In Deep Water w/ Buoys

Force is Resistance and Buoyancy
 Force is against direction of motion and up
 Illiop. Con
 Glut Max Con
 Hamstring Con
 Trap III Isometric

In Deep Water w/ Cuffs

Force is Buoyancy
 Force is up
 Glut Max Con
 Glut Max Ecc.
 Hamstring Con
 Hamstring Ecc.



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1. What force dominates with floating equipment?
2. What force dominates with sinking equipment?
3. What force dominates with neutral equipment?
4. How does a flotation belt affect aqua exercises?
5. What are the main differences between suspended and deep-water exercises versus shallow water?

6. Complete, Type of Force, Directions of Force, Major Muscle Groups Worked, and Type of Contraction

On land with weights

Force Type

Force Direction

Muscle/Contraction

In water with gloves

Force Type

Force Direction

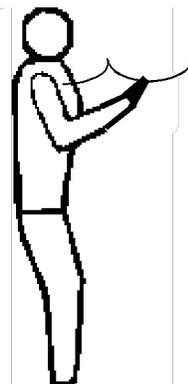
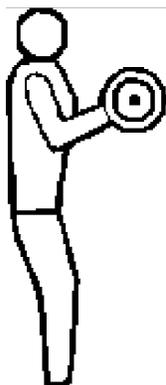
Muscle/Contraction

In water with buoys

Force Type

Force Direction

Muscle/Contraction



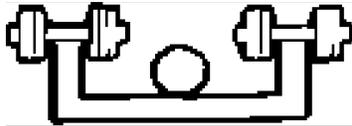
Question 7: Pec fly

On Back with Weight

Force Type

Force Direction

Muscle/Contraction



On Front with Weight

Force Type

Force Direction

Muscle/Contraction



Standing Up with Weight

Force Type

Force Direction

Muscle/Contraction



Standing in Water With Gloves

Force Type

Force Direction

Muscle/Contraction



Standing in Water With Buoys

Force Type

Force Direction

Muscle/Contraction



Suspended in Water With Buoys

Force Type

Force Direction

Muscle/Contraction



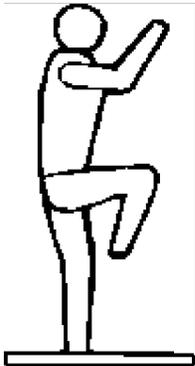
Question 8: Running

On Land

Force Type

Force Direction

Muscle/Contraction



In Shallow Water

Force Type

Force Direction

Muscle/Contraction



In Deep Water w/Belt

Force Type

Force Direction

Muscle/Contraction



In Deep Water w/ Buoys

Force Type

Force Direction

Muscle/Contraction

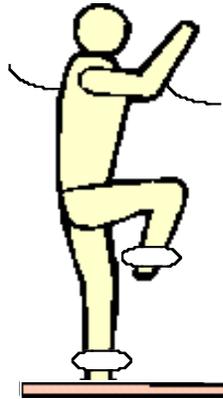


In Deep Water w/ Cuffs

Force Type

Force Direction

Muscle/Contraction



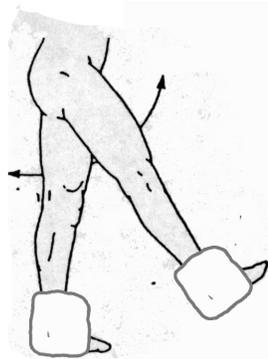
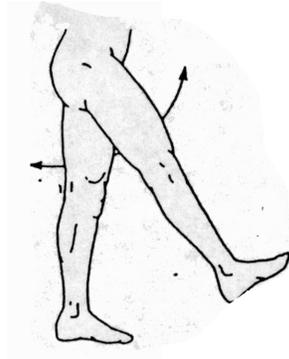
Question 9: Leg Swing Extra Credit 1(cec) Cause You Have to determine it on your own it is not in the article. So if you get it right and get 80% on the other you will get 3CEC's TOTAL

In water

In water with cuffs

Force Type
Force Direction
Muscle/Contraction

Force Type
Force Direction
Muscle/Contraction



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Billing Statement Zip Code _____ Security Code _____

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