The Kinetic Chain

- OR segmental interaction
- How our different body segments interact to produce movement

Open Kinetic Chain

- One end of chain is fixed – other is free to move
    - End of chain can move independently of the other end
- Push like pattern - All segments move simultaneously
    - Good for
        - High force
        - High accuracy
    - Simultaneous joint angle changes can result in straight path of distal segment
        - Eg darts, basketball free throw
        - For accuracy
    - Depending on orientation of segments, movement of proximal segments can influence distal
    - Proximal segments moved by large muscles
        - Distal segments working off moving proximal segments allows large forces to be produced
        - Eg shot put
        - For power
    - Speed is limited to speed of muscle shortening
- Throw like pattern – proximal segments moving prior to distal segments
    - Good for
        - High movement velocities
        - Less accuracy
    - To generate momentum/speed
        - Transfer of angular momentum
            - Angular momentum = Moment of inertia x angular velocity
            - The moment of inertia
                - Mass x radius of gyration (distribution of mass with respect to a given axis of rotation) squared
        - Storage and release of elastic energy
            - Tendon stretches
    - In tennis serve
        - Need high velocity but also accuracy
            - Though will fault a lot
            - So next shot – slower – to increase accuracy
    - Summing momentum or velocity
        - Generating momentum
            - Use as many body parts as possible
            - Put body parts on optimum stretch
            - Sequence body parts from large to small
            - Each body part should make an optimum contribution
            - High ROM should be used
        - The velocity at the end of the chain depends upon the contribution of each segment
    - The direction of release changes significantly as the point of release changes slightly
        - Decreases accuracy

Closed Kinetic Chain

- Both end of the chain are fixed
- No part of the chain can move independently of each other
- Push Like Pattern
    - Simultaneous joint angle change leads to a push like movement pattern
    - Ideal for high force production because the forces sum
    - End point of chain limited to moderate and low movement velocities – determined by speed of muscle shortening
    - Eg fend in rugby

Control of chain systems

- Both mono and biarticular muscle contribute to forces in limbs
    - Monoarticular muscle cross one joint and so are activated to directly cause joint motion
    - Biarticular muscles cross two or more joints so contribute to more than one motion
        - Useful when two simultaneous movements are performed concurrently
            - Hip flexion and knee extension in kicking
        - Redistributes muscle torque, power and mechanical energy through a limb
            - Power of a hip extension during a vertical jump can aid knee extension
    - Eg rectus femoris flexes the hip and extends the knee while gastroc flexes the knee and plantar flexes the ankle
- Specificity of chain systems
    - Controlling open and closed chains requires different muscle activation
    - Muscle activation can be altered by training – but changes are specific to training
        - So need to train movements specifically