Factors Influencing Hammer Acceleration

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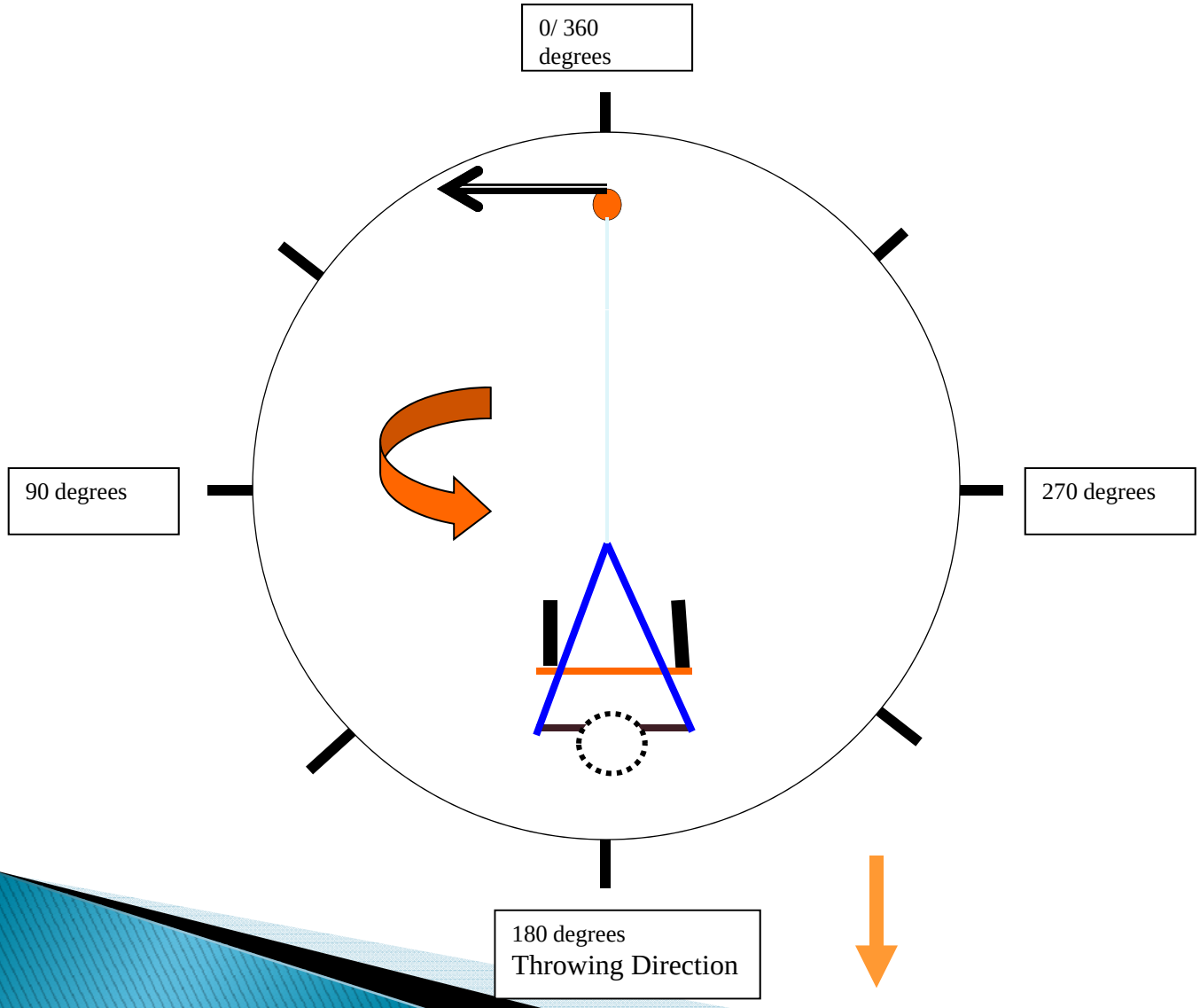
Forces that combine to drive the Hammer/ Thrower System:

- Perpendicular Forces (I.E. tangential forces)
  - Those forces at a right angle to, and in the direction of, the path of the hammer (pushing, slapping, slinging the ball in the direction).
- Parallel Forces (I.E. wire tension)
  - Forces applied parallel to the wire of the implement
  - Displacement of Center of Mass (CM)

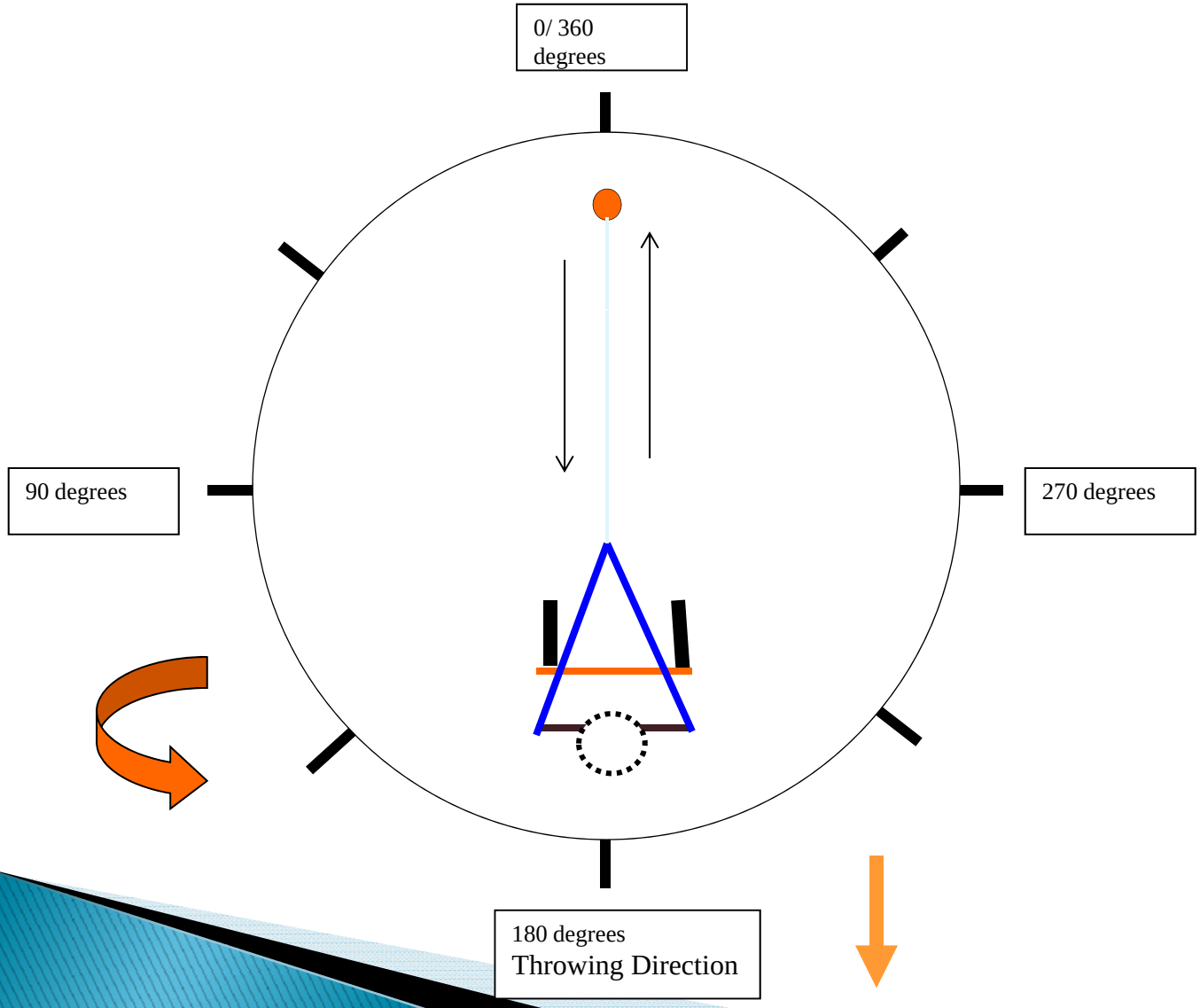
Tangential Forces: Push/ Sling

Turning Direction



Parallel Forces: Wire Tension

Turning Direction



Elements of Displacement

- **Direction**
  - Horizontal
  - Vertical (trajectory/ projection)
- **Distance**
  - Length/ depth of the movement of the CM
- **Amplitude**
  - The measure of force (impulse) applied to the CM within the parameters of direction and distance

Conceptual metaphors as a basis for understanding key hammer mechanics:

- **Pendulum** metaphor/ mechanics **(Tangential/ Push)**
  - Application of force is typically perpendicular to wire
  - Conservation of Momentum – maintenance of system force (outside gravity & friction)
  - Axis – maintenance of system force dependent on axis stability
    - Axis wobble decelerates the system
    - Movement of the axis **toward** the low point of the pendulum orbit results in deceleration of pendulum head
    - Movement of the axis **away** from the low point of the pendulum orbit results in acceleration of pendulum head
- **Spinning Bicycle Wheel** metaphor/ mechanics **(Tangential/ Push)**
  - Initial application of force is over a longer Range Of Motion (ROM), and elapsed time
  - Subsequent force applications are shorter ROM, and time **(impulse)**
  - Conservation of Momentum – a stable system axis results in maintenance and summation of system forces/ velocity
  - **Requires releasing the hand from the wheel, and letting the wheel run to utilize impulse**
  - **If the hand stays on the wheel, the wheel can only go as fast as the hand**
- **Ball on a String** metaphor/ mechanics **(Parallel/ Displacement)**
  - Initial application of force (as in the hammer throw winds) begins as tangential
  - Once the system has velocity, parallel forces are added to the system.
  - Conservation of Momentum is as with the pendulum.
  - Axis – maintenance of system force dependent on axis timing for stability

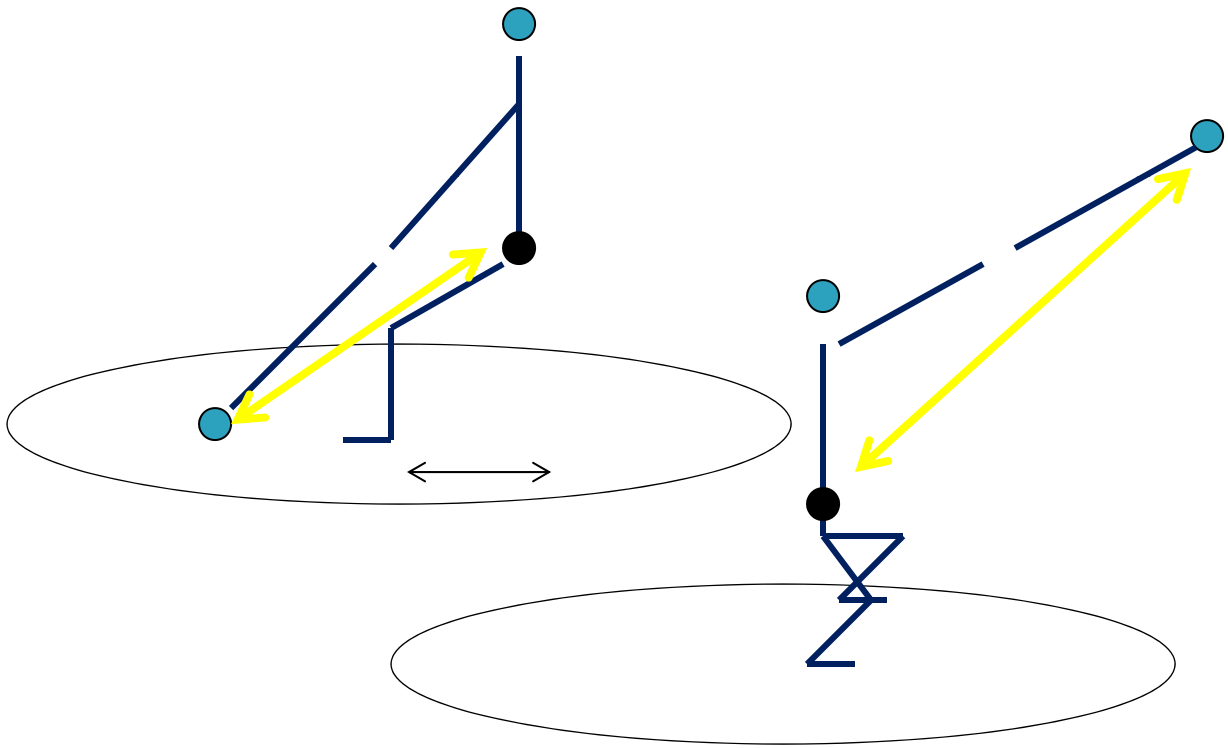
Displacement

- Double Support
  - As much as is possible, displacement should be parallel to the direction and angle of trajectory of the throw.
  - When it is not possible to displace in the direction/ trajectory, axis stability should sought/ maintained in order to reduce deflected forces (wobble).
  - The displacement of system CM is a factor of the exchange of forces between the CMT & CMI.
    - Therefore it is possible to increase displacement by actively pushing/ slapping/ slinging the ball in the direction of the throw (Ball makes sit, and sit makes more ball).
  - While the system can be accelerated with vertical displacement (I.E. standing against the bottom), this action limits the opportunity of the athlete to maintain

Displacement

- Single Support (SS)
  - Achieved by a vertical drop of the CMT against the CMI
  - Results in acceleration of the hammer head, as in the Ball on a String metaphor
  - Aids in maintaining/ restoring an effective leg angle for subsequent turns.
  - Get Down, & Stay Down (Pick a level and say there) or…
    - Lift & drop

Displacement of CMT against CMI

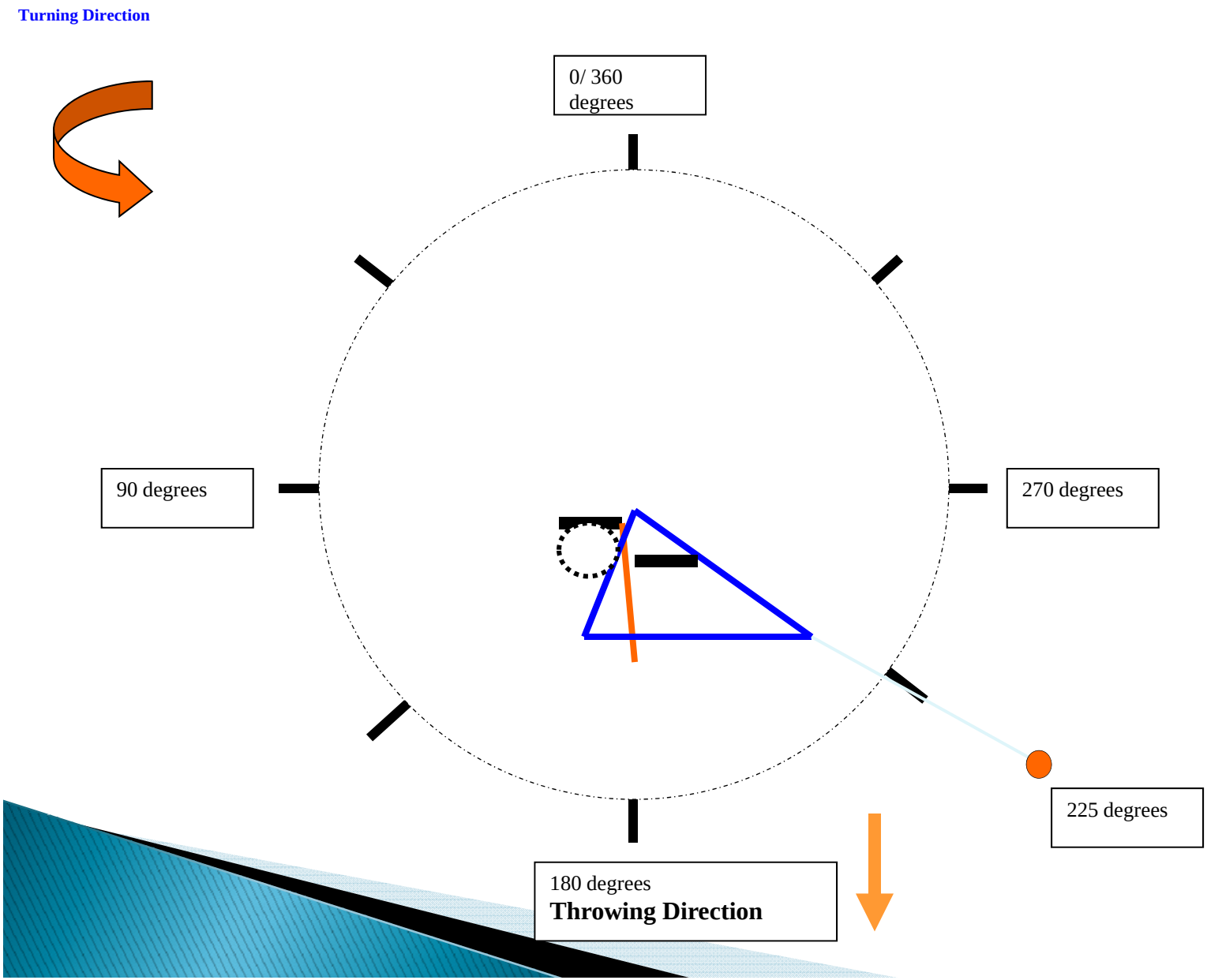


Tangential/ Pushing Forces:

Torsion & Coincidence of Axis

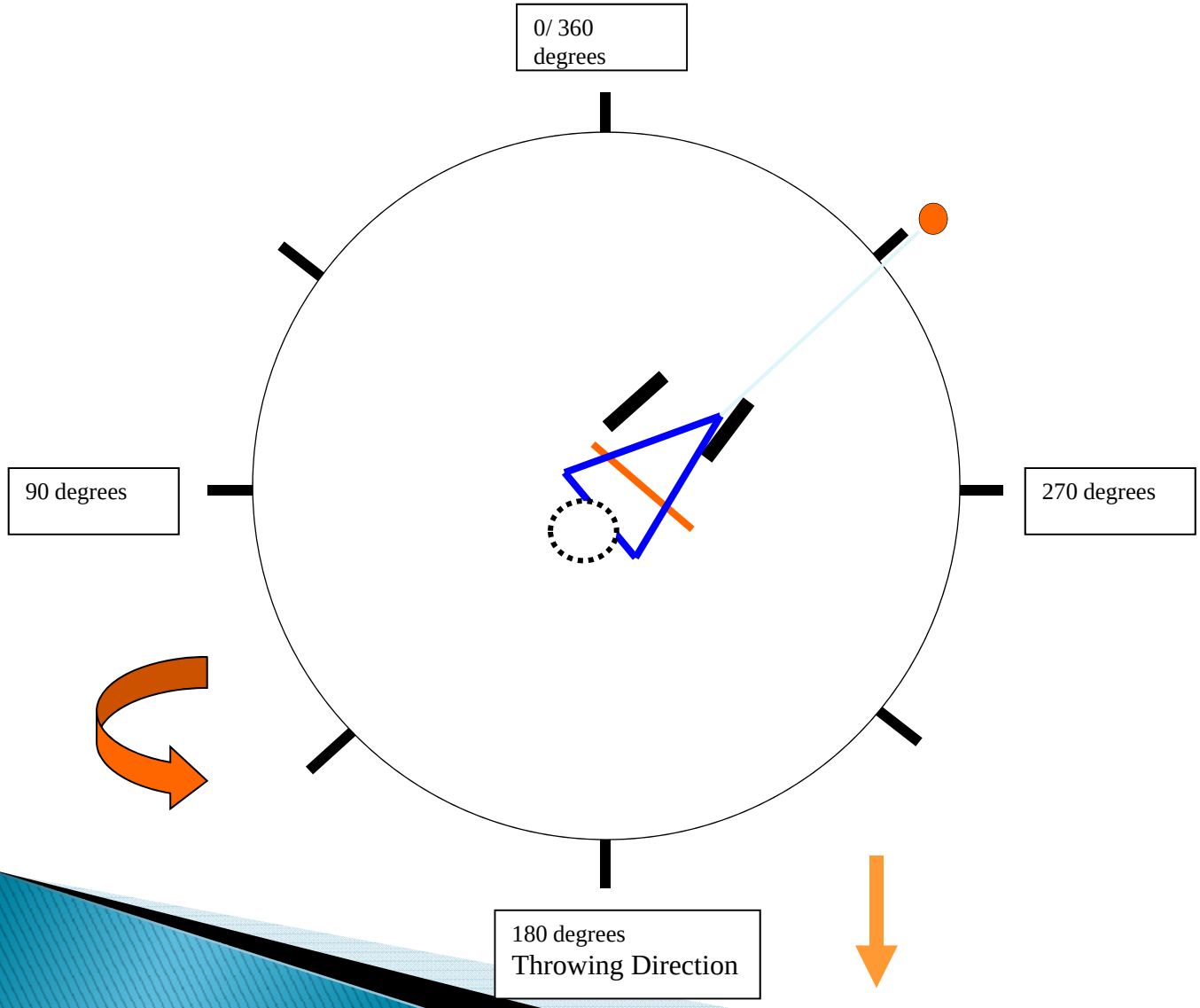
- **Torsion** – the angle/difference between the hip and shoulder axis
  - Positive torsion in hammer system is a result of angular forces on hammer head
  - Poor technique and timing increase, and fail to reduce torsion.
  - Negative torsion in the hammer system is a result of moving the hammer head in front of the system (taking the hand off the wheel)
- **Coincidence of Axis** the parallel alignment of the hip and shoulder axis.
  - The goal of the technique should be minimization, elimination and utilization of torsion.
  - While torsion is not sought in the technique the goal of making these axis parallel allows the thrower to utilize the force, such as striking the bike wheel in the metaphor.

Double Support:
Maximum Torsion

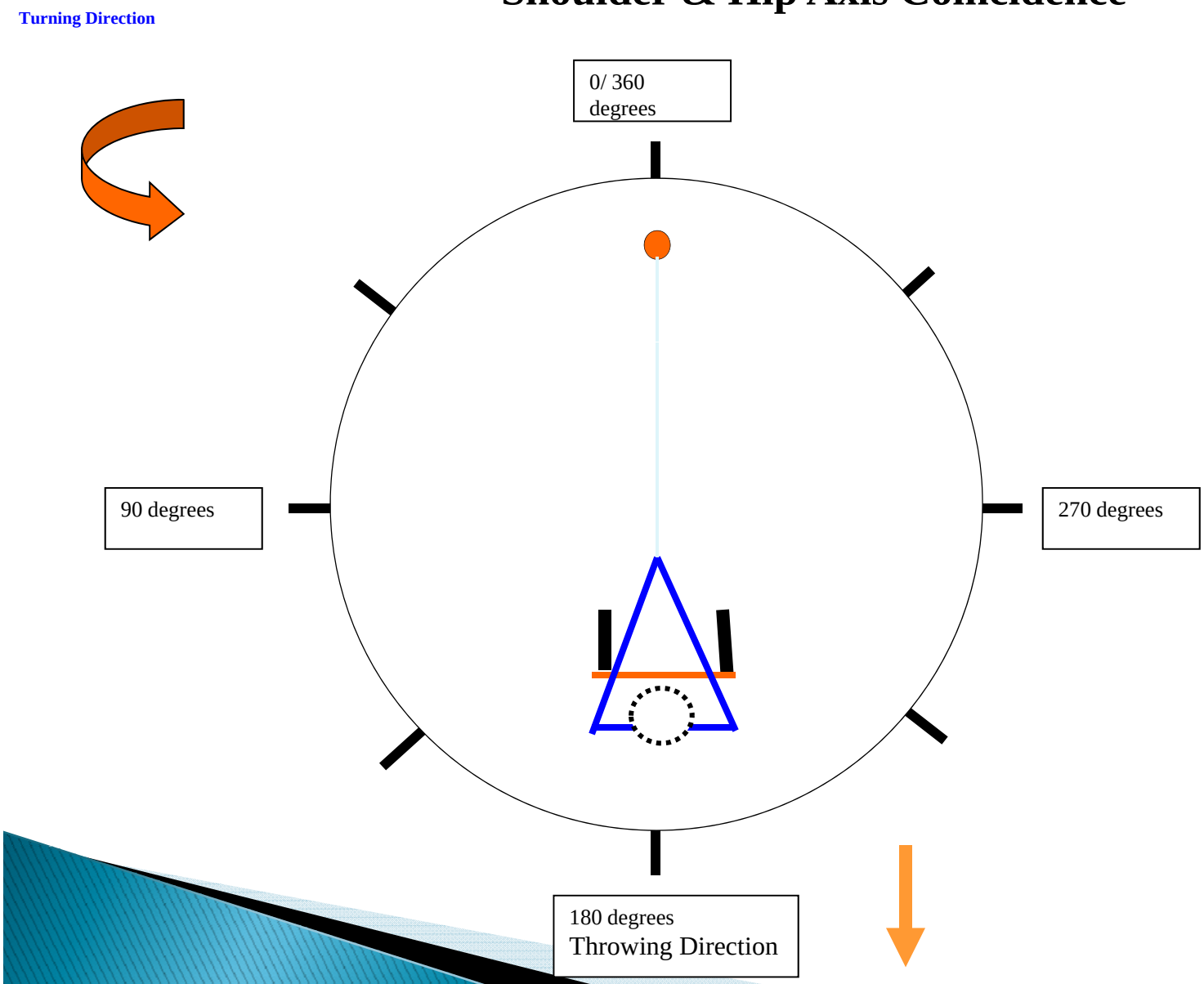


Reduction of Torsion:

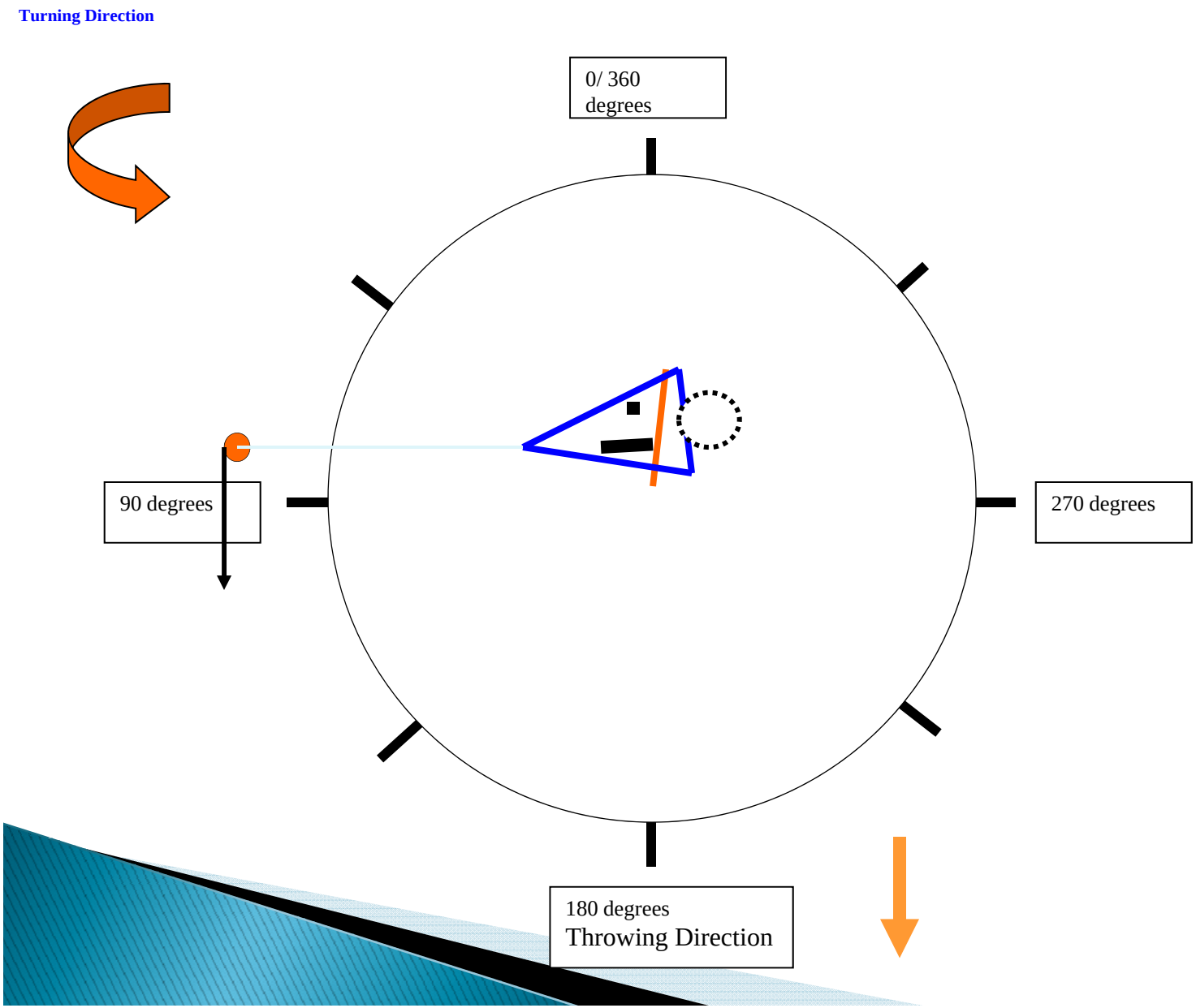
Turning Direction



Completion of Torsion:
Shoulder & Hip Axis Coincidence



Utilization of Negative coincidence of shoulder/ hip axis to turn the Hammer/ Thrower System



Hammer Acceleration Skills Identification:

Creating a drill progression based on skill themes

- **Using the Ball - turning the system with the ball (tangential forces).**
  - **Learning to turn the system from the outside/ in**
  - **learning to use the hands & torso (push, slap, sling) instead of the shoulder(s) to add to tangent forces.**

- **Displacement – teaching D.A.D. (Direction, Amplitude & Depth of CM displacement.**

- **Posture -** as a basis for balancing the system.
  - The athlete cannot seek acceleration when balance is an issue
  - The body's prime directive is preservation (I.E. don't fall)
  - Posture is dynamic. As the hammer head velocity increases, the CMT must compensate to stabilize the axis

- **Positional Strength** – strength relative to posture/ position.
  - The use of the throwers CM to compensate for the increased force as a result of hammer acceleration.

Hammer Skills

- Turning on an axis
  - Double support
  - Single Support
- Torsion
  - Creation of torsion
  - Reducing Torsion
  - Utilizing torsion
  - Shoulder Axis/ Hip Axis Negative Coincidence
- **Displacement/ Countering**
  - **Postural displacement**
  - **Vertical & Horizontal**
- Double arm throwing based on single arm skills
  - Single arm throws
    - Right hand drills
    - Left hand drills
    - Integrate/ combine single hand skills toward two hand throws
- Use of metaphors in teaching skills
  - Pushing, Slapping, Whipping
  - Swinging/ Slinging & the Pendulum & Bicycle metaphor

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