# Physics of Football Notes

## Characteristics of an effective passer:

-High velocity, high accuracy -Maximize range limits interceptions

## How do we increase velocity and accuracy?

-Spin the ball along long axis and point long end axis in the direction of the target.

## Out of all the possible throwing motions, why is overhead sidearm the best?

-Because it allows you to put spin along the long axis with its long axis pointing to the target.

## Aspects of overhead sidearm throwing motion that give you maximum accuracy and velocity:

-minimized surface area exposed to air resistance

-motion allows torque from center to outside that creates spin

## Why not a soccer ball throwing motion?

-Aerodynamic drag -F=ma F=Pa

## Why is spin important?

- torque causes spin torque=force x distance

-Spinning results in balls angular momentum that keeps ball's long axis pointing forward.

-Angular momentum is conserved, so ball will stay spinning unless another force acts upon the Momentum.

## Ball's Trajectory due to spin:

-trajectory affected mainly by gravity and aerodynamic drag

## How does the way one grips the ball affect the outcome of the pass?

- Hall of Fame quarterbacks Terry Bradshaw and John Elway, both known as quarterbacks with strong arms who can throw the ball very far. They hold the ball towards the back so a greater force can be applied along balls direction of launch.

-Troy Aikman another Hall of Fame quarterback more knows for his precise, accurate and touch passing holds the ball towards the middle so that he has much more control of the ball.

## All this talk about throwing the ball, what about catching the ball?

-Soft hands allows for:1)pressure by fingertips (friction in opposite direction)2)increased time to stop V

## Newton's Laws as they relate to blocking and tackling:

**First Law:** Mass wants to continue what its doing whether its at rest of in motion. Unless acted on by an external force, the natural state of matter is to continue on its initial straight line path indefinitely. Also states that the more massive an object the more it wants to continue doing what its doing and the less likely it is to be deflected, slowed down or sped up by an outside force. Example of 318 pound defensive lineman William "the Fridge" Perry who was brought in as a running back during the Super Bowl because the momentum he gained from running out of the backfield would be hard to stop from a distance of three feet away.

**Second Law:** The force applied to an object is the product of the object's mass and its acceleration. F=ma. Linebacker Dick Butkus tackles a fullback who weighs the equivalent of him(245 pounds). The back is running at a speed of 30 feet per second. The duration of the hit lasts 2/10 of a second. We divide speed change by the time interval to get the acceleration or in this case deceleration.

**( 0 ft/sec-30ft/sec)/0.2 sec=-150 ft/sec** By sticking to pounds rather then converting to kilograms we can state that F=(1/32)ma, so **(1/32) x -150ft/sec x 245lbs=-1,150 pounds of force**

**Third Law:** Whenever two objects collide, no matter what their individual masses , or how fast they're traveling, they always exert the same amount of force on each other, just in opposite directions. Using the previous example the fullback exerts a positive 1,150 pounds of force on Dick Butkus, it is just in the opposite direction.

## Tackling and Torque:

Tackling as taught on every level says that you should stay low with your feet apart and head up while driving upward and through the opposing player. The reason to stay low and drive upward is so you can Control his motion by exerting more torque on him then he does on you. Although Newton's laws still

hold true, by controlling the centers of mass of another player you can dominate him and take him down.