III.Biomechanics

Standing on one leg, weight go through one
Is 5/6W [W = body weight]

Moment arm:
Abductor moment is 5 cm
Body moment arm is 15 cm

Abductor Force for equilibrium for standing on one leg is 2.5W

Joint Reaction Force [JRF]
Joint reaction force (Fj) in equilibrium: Fa + Fw = Fj
JRF = 2.5 +5/6W = 3.3W N

This can also calculated by : Simple geometric construction of triangle. When equilibrium, triangle is closed. If two sides are known, third side can be calculated.

Modification of the Joint Reaction Force

1.Changing the level arm

Lateralisation of the centre of gravity by leaning towards the affected side, reduces the functional length of the body weight level arm therefore reduces the JRF.

This occurs in the limping patient

2. Change in the body weight, reduces the body weight lever arm. Approx 1Kg wt loss results in reduction of JRF 3 Kg.

3. Changing the adductor lever arm

Changing the length of the adductor lever will affect the JRF. This is related to

a. Femoral neck length
b. Neck shaft angle
c. Prosthesis offset post THR

Joint Reaction
Force

1. Shortening the neck = Increases the JFR.
2. Lateralising the trochanter = reduces the JRF
3. Medialisation of the cup, the JRF is reduced by the shortening of the weight lever arm.

4. Increasing offset reduces the JRF

Coxa Vara – adductor lever arm is lengthened

Coxa Valga – abductor arm reduced.
Abductor force more vertical.
As long as JRF pass through the centre of the head the stress is evenly distributed.
If it is lateralised the forces are concentrated on the lateral acetabulum. An increase sourcil sclerosis is noted.

Lateral acetabular osteophyte formation results from abnormal loading of the bone, Wolf law – bony adaptation as a result of altered forces.

Medial osteophyte formation do not increase the weight bearing surface. They cause further laterlisation of the femoral head and as a result further lateral acetabular sclerosis.