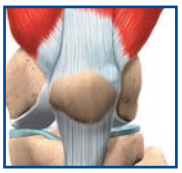
ANATOMICAL CHARACTERISTICS REFLECTING HUMAN ADAPTATION TO BIPEDAL LOCOMOTION.

There are at least nine main anatomical characteristics that reflect human adaptation to bipedal locomotion, as compared to say chimpanzee adaptations. For convenience, we can group these into two main sections - the adaptations of the lower limbs and pelvis, and the adaptations elsewhere in the human body:



1) Knees. Humans can 'lock' their knee joints into an extended position during the stance phase thereby using less muscular power and hence energy.

2) Thighs. Humans have an inward sloping angle of the thigh (the valgus angle) and when the two feet are at rest they are placed very close to the midline of the body so that the body's centre of gravity does not move laterally very much. This leads to more efficient and energy saving walking.

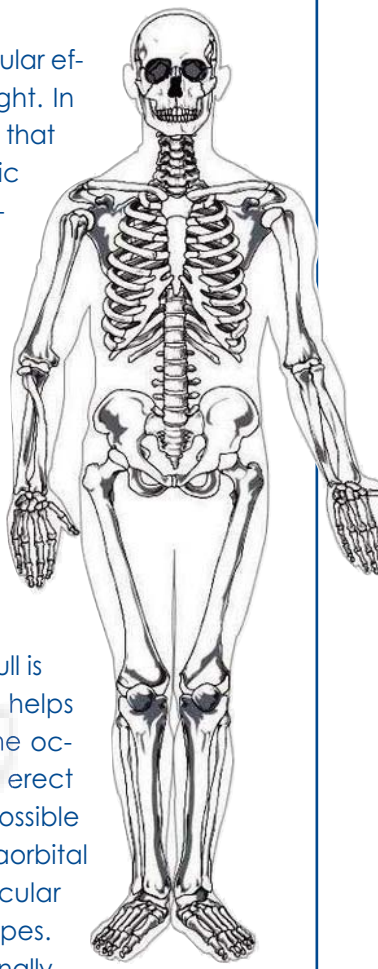
3) Feet. The shape of the human foot with its arches makes it more of a propulsion lever than a grasping kind of chimpanzee foot. Human feet also have the enlarged great toe brought in line with the other toes for more efficient walking.

4) Pelvis. Humans have a shorter, broader pelvis with reorganized musculature. This point allows the thighs to be angled in, as we see in point 2 above.

5) Lower Limbs. In general the lower limbs of humans are lengthened in comparison to chimpanzees and have enlarged joint surface area to bear weight.

Away from development of the lower limbs and pelvis we see other adaptations to bipedal locomotion in humans.

6) Spine. Humans have a curved lower spine - the lumbar curve. Here (according to a 1990 study by Aiello, Leslie and Christopher Dean) without the lumbar curve, the vertebral column would always lean forward, a position that requires much more muscular effort for bipedal animals. With a forward bend, humans use less muscular effort to stand and walk upright. In addition we should also note that the lumbar and thoracic curves bring the body's centre of gravity directly over the feet.



7) Skull. The foramen magnum is moved towards the centre of the basicranium. Again, this is more efficient in an upright posture. Chimpanzees have their foramen magnum nearer the back of the basicranium. Another adaptation we see in the human skull is the flat human face which helps maintain the balance on the occipital condyles, so that an erect position of the head is possible without the prominent supraorbital ridges and the strong muscular attachments found in apes. Again this will save energy. Finally we could consider some lesser known adaptations which can include:

8) adjustments to the inner ear, since bipedal animals must be able to balance on two legs and also

9) the rib cage of bipeds is barrel shaped, in contrast to the inverted V-shape of the apes. These are the main anatomical characteristics that reflect the human adaptation to bipedalism. Finally, the human anatomical adaptations to bipedalism perhaps can not be considered complete. Slipped disks, weak backs, choking, hemorrhoids, obstetric difficulties, weak knees and varicose veins can all in some cases be attributed to incomplete adaptation.

Simon Harding

References

"Human Evolution An Illustrated Introduction" 2005 Roger Lewin

"An Introduction to Human Evolutionary Anatomy" 1990 Christopher Dean, Leslie Aiello