The Question: पक्षी सोते वक्त पेड़ से गिरते क्यों नहीं हैं?

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Answer:

Birds grab hold of a tree branch by curling their talons around it. The question is how do they manage to keep holding on to that branch even while sleeping? If you went to sleep holding on to something, at some point your muscles would relax and you let go of what was in your hand. How is it that birds don't relax their feet while sleeping and let go of the branch?

The answer is that birds grasp branches using their talons, and the reason that they don't fall off while asleep is that it is an involuntary reflex. When they perch on a branch, that is when the land on the branch and they bend their legs to sit on it, their talons automatically clasp it and lock on to it. Their feet let go of the branch, unlock the talons only when their legs straighten. So long as the bird is sitting, it will stay locked on to the branch. In other words, even if the bird wants to, it cannot let go of the branch so long as its legs (ankles) are bent.

An Involuntary Reflex Action For you to try – Box 1

We can do an easy activity to literally get a feel of an involuntary reflex action!

Here's how: Extend any one of your hands horizontally in front of your face, palm open and facing upwards, fingers loosely stretched outwards in a relaxed manner. Now using the palm and fingers of your other hand, grip the extended lower arm of your hand about your little finger's length away from the wrist joint. Then quickly tighten your grip around that lower arm, and release it, tighten it again, and release it again……

Did you notice what happens to those loosely outward stretched fingers of that extended hand as you tighten your grip on it? Don't they curl inwards automatically, and open up again as you soften your grip? Keep doing it and see……

The most important thing to realise here is that our brain is not actively telling our fingers to curl themselves inwards – instead here it depends simply on the physical force being applied by the tightness of your grip on a specific region of your lower arm. In fact in this case – your brain needs to actively tell your fingers not to curl themselves inwards to keep them in their outstretched position while the grip is being tightened.

Try it: Tighten your grip around that region of your lower arm again, but this time keep the outstretched fingers in their outstretched position. Do you think it is happening as automatically as the curling of the fingers while the grip was being tightened earlier? Do you think your brain is playing an active role in this case, rather than compared with the previous case?

Thus, in a nutshell, that curling movement of your fingers during the first test did not really depend upon what you wanted them to do. Rather it happened involuntarily due to the gripping action. In other words, that finger-curling movement has a big physical

reason behind it, and not an entirely physiological one like what happens when you decide to grab hold of the railing alongside a flight of stairs.

The locking mechanism of perching birds

To understand how this happens, we need to understand the series of involuntary actions initiated a by a tendon in their legs, a mechanism that was first discovered in bats.

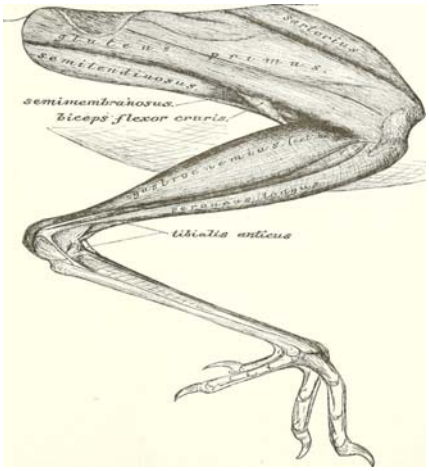
Birds' feet and toes are mostly tough tendons and bones, covered with heavily-scaled skin (Figure). (There is a limited supply of nerves, blood vessels and muscles, and this is what enables them to land on cold metal perches when temperatures drop.) A tendon is a tough band of connective tissue that usually connects muscle to bone and is capable of withstanding tensile force. Tendons are made of a kind of protein called collagen.

<u>Find a tendon – Box -2</u>

Tendons have a vital role to play in movement of our own bodies.

Let's get a literal feel for one of them right this moment. There is one tendon in every human being called the Achilles tendon. It extends from our calf muscle around the back of our foot to the heel. Reach down right now on your leg and feel it. This tendon enables us to flex our foot up and down. Flex your foot and see if you can feel it. If the Achilles tendon becomes injured, the foot would be almost immobilised.

In case birds' legs, the tendon, toes and muscles are so situated anatomically that perching is almost automatic (or inescapable). How? First look at the next diagram of a bird's leg.



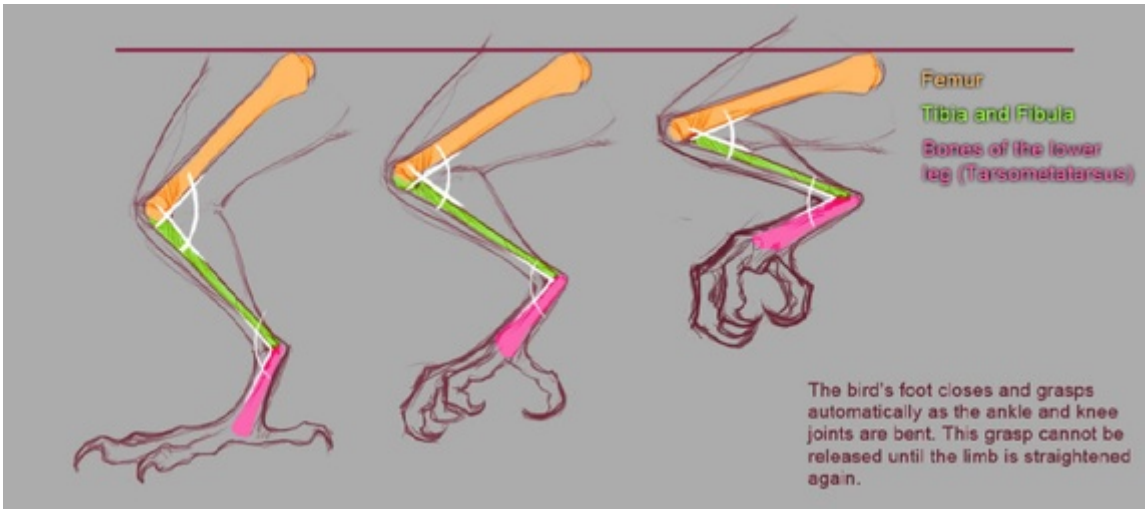
There are the toes, of course, but notice that the long bone above the foot is actually the ankle! The tibia and fibula, which make up our lower leg bone, are hidden by the bird's feathers, as is the femur.

In case of birds, their equivalent of our Achilles tendon, two thin tendons called flexor tendons, extend from the calf muscle that runs just above the ankle to the back of the foot and then along the bottom of the toes where they attach.

When a bird lands on a branch, its ankle bends and these tendons are stretched. When the tendons stretch, it pulls on the toes and curls them around the branch. There is no muscular effort involved in holding onto the branch. Rather, it's automatic– instead of expending precious energy holding the muscles tight – as you would if you were hanging onto a branch with your fists/arms – the system simply physically locks in place. This involuntary reflex keeps a sleeping bird from falling off the branch. The tendons stay tight until the legs straighten.

As the bird stands up, its legs straighten, the tendons relax and the toes unlock to release the feet. Falling asleep doesn't change the grip, as the weight of the bird keeps the leg in the locked position.

See the picture below to get a better sense of how that automatic action happens:



Good for the birds as well. Otherwise their brains may have been incapable of doing anything else on a windy day other than continuously directing their talons to not lose their grip from those branches and wires!

Do all birds lock their toes?

A study across all bird orders found that a large number of species possess the anatomical features (such as forward and backward facing toes, flexor tendon) for perching with the above described digital tendon locking mechanism. These include passerines (more than half the bird species belong to this order, including crows, bulbuls and sparrows), many raptors (birds of prey such as falcons, owls etc.), pigeons and water birds as well. We also know that they use this mechanism for diverse activities such as swimming, wading, prey-grasping, clinging, hanging, and tree climbing.

The locking mechanism has specifically been studied in passerines. However, we do not know for certain whether all birds that have the anatomy for this kind of grasping actually lock their feet over branches, as there are exceptions amongst these birds. One such exception is that of the European startling, a passerine. These starlings (which are quite like

our mynahs) don't grasp branches as described above. They balance on branches on their toe pads.

The sleep of birds

In finding an answer to our question, we also need to consider how birds sleep. Unlike humans, birds (and most other animals) don't sleep for several hours at a time. They sleep in snatches. In many of them, their entire brains don't fall into sleep mode – a part of their brain remains alert - which is why some of them can sleep while flying and some stay alert for predators while sleeping. So, whether they need to use an involuntary locking mechanism to not fall off their perches while 'asleep' is not clear.

I think we can say that it is likely that many birds perch on trees and sleep without falling off due to the digital tendon locking mechanism, but we are not certain that this is how all of them stay balanced and asleep on trees.