How did Michael Jackson challenge our understanding of spine biomechanics?

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In 1987, a new music video, “Smooth Criminal,” showed Michael Jackson (MJ, as he is known to his fans) performing a mind-boggling dance move. He leaned 45° forward while keeping his spine straight, using only his feet to prevent him from falling (Fig. 1A). Those who believed that special effects had been used in the video were shocked to see this man, also known as the “Moonwalker,” perform the move in live concerts all over the world. For generations since, dancers have tried to emulate his movements and have developed the dance form he introduced into a new challenge to our understanding of spinal biomechanics. But did MJ really achieve the impossible?

When the human body stands erect, its center of gravity (COG) lies in front of the second sacral vertebra. Studies of biomechanics and kinesiology suggest that, as we bend forward with a straight torso, keeping our hip joints as the fulcrum, the erector spinae muscles act like cables to support the suspended spinal column during the forward shift of the COG, preventing the body from falling forward. However, when the fulcrum for forward bending is shifted to the ankle joints, the erector spinae lose their ability to maintain the COG, and strain is shifted to the Achilles tendon (Fig. 1B). This allows for a very limited degree of forward bending from the ankle joints, while keeping a stiff straight posture—unless you are Michael Jackson. Most trained dancers with strong core strength will reach a maximum of 25° to 30° of forward bending while performing this action. MJ pulled off a gravity-defying 45° move that seems unearthly to any witness. Several MJ fans, including the authors, have tried to copy this move and failed, often injuring themselves in their endeavors.

As much as we would like to believe that MJ broke...
the relationship between physiology and physics, a patent registered under his name shows that the move was accomplished with a clever invention. Along with fellow inventors, MJ developed a special shoe that had a slot in the heel. The triangular slot could engage a hitch member (a metallic peg, which emerged from the stage floor at just the right time), allowing the dancer to obtain the right amount of extra support to be able to lean forward beyond physiological limits (Fig. 1A). Alas, MJ’s move was an illusionary trick. But even with specially designed footwear and the support of the hitch member, the move is incredibly hard to pull off, requiring athletic core strength from strengthened spinal muscles and lower-limb antigravity muscles.

Trick or not, new forms of dancing inspired by MJ have begun to challenge our understanding of the modes and mechanisms of spinal injury. Ever since MJ entertained us with his fabulous moves, throughout the world dancers have tried to jump higher, stretch farther, and turn faster than ever before. The hip-hop style of dancing and, particularly its offshoot, b-boying/b-girling are two styles that include significant elements of acrobatics. Stresses on the spinal column experienced by dancers of those styles are very high and frankly a bit odd. The rapid rise in popularity of dance as an art and exercise the world over is bound to produce new forms of injuries that may perplex the neurosurgeon. The situation will become more complicated when a dancer, who has received a surgical construct for fixation, wants to continue dancing. The art of movement is life itself for many dancers, and it remains to be seen how surgical implants will hold up to the stresses of dance. While many new questions need answering, what is certain is that all this is owed to the ever-fresh inventiveness and style of “The King of Pop.”

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References


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