Are you a stick-in-the-mud or swinging stifle surgeon?

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Tibial plateau leveling and tibial tuberosity advancing procedures have become increasingly common place surgeries for treatment of cranial cruciate ligament deficient stifles in the canine. The plethora of acronym based procedures (TPLO, TTA, TTO(TWAO), TWO, PWO, PTIO) all claim to biomechanically alter the stifle rendering the cranial cruciate ligament redundant. These claims have evolved from Slocum and Devine’s 1983 study into the mechanics behind cranial tibial thrust which suggested that thrust was the resultant shearing force created by compressive forces across the stifle joint. This concept has been revised and propagated through the literature for almost 25 years resulting in the description of surgical procedures that have been based on simple two dimensional static theories with little in the way of published biomechanical studies to back them up. In fact only TPLO and more recently TTA have had any kind of biomechanical assessment performed and due to the complexity of the canine stifle, these studies have been overly simplified models of denuded hind limbs potted in clay (‘sticks-in-the-mud’) at fixed stifle and hock angles, with a constant estimated vertically applied force and with vague and minimal muscle considerations. A number of studies exist showing the dynamic nature of the stifle throughout the gait, these include studies demonstrating:

1. Significant changes in cranial cruciate ligament strain throughout the stance phase of the gait
2. Instantaneous centers of rotation at the joint level indicating that loss of equilibrium on either side of the joint will result in rotational movement rather than sliding
3. Changing vertical ground forces throughout the stance phase
4. Changing angles of stifle flexion and tibial angulation relative to the ground throughout the stance phase
5. Analytical estimations of the changes in forces exerted by the different muscle groups while walking

Only by understanding the changing requirements of the canine stifle for cranial cruciate ligament function throughout the stance phase can we truly assess the biomechanical efficacy of these surgeries in making the ligament redundant and providing joint stability. Further biomechanical studies are required with dynamic modeling before we can justify calling ourselves swinging stifle surgeons.

1 Slocum and Devine Cranial Tibial Thrust: A primary force in the canine stifle; JAVMA 1983 183:456-459

3 Tepic et al. ¡Biomechanics of the stifle joint¡ 2002 1st World Orthopaedic Veterinary Congress

4 Warzee et al. ¡Effect of Tibial Plateau Leveling on Cranial and Caudal Tibial Thrusts in Canine Cranial Cruciate-Deficient Stifles: An In Vitro Experimental Study¡ Vet Surg 2001 30:278-286


7 Shahar and Banks-Sills ¡A quasi-static three-dimensional, mathematical, three-body segment model of the canine knee¡ J Biomech 2004 37:1849-1859


10 Ireland et al. ¡Location of the instantaneous center of joint rotation in the normal canine stifle¡ AJVR 1986 47:837-840


13 Hottinger et al. ¡Noninvasive kinematic analysis of the walk in healthy large-breed dogs¡ AJVR 1996 57:381-388