

Seminar by Prof. dr. J.N. Leijnse, PhD

Time: Thursday February 22. 10.00 am.

Location: Pontoppidanstræde 103. Room. 4.106.

The seminar has been split into three separate parts with time for questions after each.

Pushed to the limit and beyond – anatomical hand variations as biomechanical causes of instrument-technical playing problems in musicians

Although from the hunter-gatherer the need for finger independence generally increased with the advancing civilization, the human hand yet did not evolve to play Rachmaninov. In fact, where instrumental playing requires independent finger control, anatomical finger independence remains limited but highly variable in the population. When anatomical limitations prevent useful playing motions, playing problems may arise. By a still controversial biomechanical hypothesis, anatomical limitations might even trigger control problems, known as focal hand dystonia in the musician (FHDM). FHDM is a painless finger control problem in playing, in hands that in daily tasks function normally. The causes of FHDM are still considered unknown, no effective cure exists and FHDM usually ends a performing career. The biomechanical hypothesis implies that in selected cases, surgical modification of anatomical limitations might benefit FHDM patients. The lecture will present a review of anatomical limitations of finger independence and a biomechanical model of such limitations as risk factors for FHDM, illustrated by clinical case studies.

The human finger is uncontrollable by its muscles alone

How many muscles are minimally required to control a chain of joints of in total N degrees of freedom? This question is central in understanding the basic design of the finger. It will be demonstrated that the finger lacks sufficient muscles to control the primary degrees of freedom in its joints, and that additional tendinous mechanisms are necessary for normal finger control. Trauma or deterioration of each of these structures gives typical clinical dysfunction by sometimes complex multiarticular interactions. However, the lecture will only discuss the basic layout of muscles and mechanisms. For the musicians' hand, despite the large total number of degrees of freedom in the hand joints, the low control redundancy in the finger makes it possible to conduct useful biomechanical analysis of anatomical limitations in playing.

Anatomical limitations and conflicting functional demands: - the joint fixation mechanisms of the finger extensors versus finger independence

The extensor tendons run in an unstable position on top of the spherical metacarpal heads (MCHs). If the tendon would glide down from the spherical joint surface, the finger cannot be extended anymore and the hand becomes useless. Therefore, robust ligament fixations keep the extensor tendons aligned at the MCHs. Morphologically, these systems are interesting because the solution for the fixation problem is not unique. In other words, the morphological optimization point is a broad area. This reflects in a large range of anatomical variability that remains functional for extensor tendon fixation. This is not the case for the function of finger independence. One of the fixation systems also limits finger extensor tendon independence, with variable consequences for musical playing.