HOW A SPORTS-ORTHOPAEDIC SURGEON REALIZED THE IMPORTANCE OF BIOMECHANICS

Prof. Ejnar Eriksson, M.D., Ph.D.
Professor Emeritus of Sports Medicine at the Karolinska Institute, Stockholm, Sweden

During almost 50 years of sports medicine, I rapidly learnt to appreciate the importance of sports biomechanics but only slowly learnt to understand it. It has been said about us orthopods that we need to be twice as strong as an ox but only half as smart. What I will tell you in my lecture is how I gradually have come to realize that sports medicine simply cannot exist without sports biomechanics.

In the early 1970-ies I was seeing a number of breaststroke swimmers coming to me for medial knee pain. Their X-rays were always normal. Arthroscopy (which was new then) revealed medial synovitis of overuse type. I therefore wondered if there could be something in the whipkick of the breaststrokers that was responsible for their knee pain. Some of the breaststrokers never had any knee pain. I therefore collected a group of swimmers with and one without medial knee pain during or after training breaststroke. I also contacted Paavo Komi and his student Keskinen and furthermore obtained permission to use the then new swimming flume of the School of Physical Education in Stockholm. Although, there were already computerized motion analysis systems available at that time, one could not use them in water. We therefore marked the swimmers and shot high speed 16mm colour movie film through a lateral window and through a newly built glass window kept over the swimmers back in order to avoid the reflections in the moving water.
We found that the swimmers with knee pain abducted their legs much more than the swimmers without knee problems. This information was passed on to the coaches and medial knee pain in breast stroke diminished considerably.

I learned to understand the value of three-dimensional motion analysis and EMG from the late professor Evert Knutsson, M.D. at our Clinical Neurophysiology lab. of the Karolinska Hospital in Stockholm. I particularly remember one patient, one of our best marathon runners. He came to me with a strange medical history. He could run perfectly for 2 hours 5 minutes but after this he started to limp badly and was rapidly passed by a number of other competitors. He had been examined in a number of hospitals and by all types of doctors, trainers, PT:s, chiropractors etc. No-one understood why. Nor did I. I then contacted Evert Knutsson and we put EMG electrodes on a number of thigh and leg muscles of the runner. We also put reflectors for a very early and simple computerized motion analysis system on him and had him run on a treadmill at the same speed at which he was normally running marathon. We had a colour TV-camera recording his running and super-imposed his EMG over the running picture. We then had him run for 2 hours. After 2 hours 5 minutes he started to limp badly. We found that it was his hip flexors that gave up. We gave him a training program to strengthen his hip flexors and train their endurance and taught him to stretch his ileo-psoas. 2 months later he could run 2 hours 20 minutes without problems.

1979, I visited Burlington, Vermont, invited by Robert J Johnson, M.D., who had been a fellow of mine a year earlier. In Burlington I met a young engineering student by name Steve Arms. He showed me what he then called a Hall-effect strain transducer (today DVRT) but complained that no one in Burlington was really interested of trying it clinically. I invited him to Stockholm and we did some interesting cadaver studies together. Steve and Inga Arvidsson, who did this study in our pathology lab., actually won the AOSSM O´Donoghue-price for this study. But even more interesting from a historical point of view is that I managed to get permission from the Ethical committee to temporarily implant a DVRT on a reconstructed PT-ACL. When the motor block of the patients epidurals had worn off, we had them (4 patients) lift their legs, extend their legs etc. We were able to show that when the patients contracted both their hamstrings and quadriceps, there was little load on the ACL but extending the knee "open chain" caused much more elongation of the ACL than a very powerful Lachman test. These studies were done 1980-1981.

When I became professor of Sports Medicine at the Karolinska Institute I was fortunate enough to get a resident with very good knowledge of biomechanics, Gunnar Nemeth, M.D. He has subsequently become professor and chairman of the Dpt. of Orthopaedics of the Karolinska. Together we studied the EMG of back and trunk muscles of cross country skiers in the classical diagonal style and in the new skating style. As I am sure you are aware of there is a lot of back problems in the classical diagonal style but very little in skating.

We also tried to find out why, when and how the sprinters sustain hamstring muscle ruptures. We collected a group of sprinters who very often sustained such injuries. We put EMG electrodes on a number of their muscles and filmed them with a TV-camera superimposing their EMG:s. We then stimulated them to run as fast as they possibly could, hoping that someone might sustain a tear while we were recording. Our theory was that the ruptures occur when they get tired and that their fine-tuned innervation of both functions (flex the knee and extend the hip) breaks down. Unfortunately - or should I say fortunately - no one tore any hamstring muscle during our experiment. One day later, one of them sustained a hamstring rupture, though. I am sure this is the type of study we have to do to really find out what happens during the rupture.

Finally, let me assure you that our host here in Ottawa, Mario Lamontagne has taught me a lot. When prof. Giuliano Cerulli wanted me to come to Perugia in Italy after my retirement, one of the first things I did, was to invite Mario to come there as a consultant. He and Giuliano will tell you about the fascinating studies being performed there. I can only say, that although I am a stupid orthopaedic surgeon, I realize how extremely important sports biomechanics is. And I am happy to be invited to this excellent conference.