



WHAT DOES IT DO?	RESULT
Pelvic Fixation	Maximum sitting-stability
Pelvic Rotation forward Lumbar spine rotation forward	Maximum ability to put the trunk into the propulsion position (ATP), resulting in maximum propulsion power and acceleration
Stretching of the spine	Maximum reach
Mass-centering around vertical rotation angle	Maximum manoeuvrability

ATP-knee seat sports wheelchair

Performance in wheelchair sport is always dependent on three main subjects; the athlete himself, the equipment / sports wheelchair and... the interface between athlete and wheelchair. The last performance factor is mainly dependent on sitting-posture and position, we have seen an evolution on this item during the last 20 years.

In fact we have seen, till now, four different seating-postures through the years:

1. feet forward posture
2. feet under posture
3. feet rearward posture
4. knee seat posture

In the very beginning athletes were sitting with the legs in front. This is not an ideal posture for power generation. The pelvic is rotated backwards and the spine curved kyfotic. Soon they changed to the posture with the feet under the knees. Later this posture changed to the feet rearward posture in order to have the pelvic rotated forward and the spine stretched. This is a far more ideal posture for power transformation. The fourth posture is the one with the feet tucked under the buttocks. This is known as the 'knee-seat-posture' and is the ultimate posture for power output, until now we only see this posture in wheelchair racing and handbiking. This is logical because in both sports speed is the ultimate goal and speed can only be achieved with optimal power output. Wheelchair racing athletes are sitting in the knee seat position for about 15 years. Some 7 years ago this knee seat posture was also introduced into the handbike scene by Double Performance, a specialized shop for sports wheelchairs and handbikes from the Netherlands. And with success; most C-athletes worldwide are racing now in this position.

So, it is a logical step to introduce this fourth posture also into wheelchair tennis, badminton, basketball and hockey. In September 2007 RGK and Double Performance introduced the first ATP (Arm-Trunk-Power) knee seat sports wheelchair. The advantages of this new type of sports wheelchair are the improvements in sitting stability, power transmission / acceleration, reach and manoeuvrability. These advantages will be described in this article.

Stability

The actions done by the athlete in a sports wheelchair can only be effective when there is a good sitting stability. That is the reason why strapping has become so popular. Only with a fixed base the power-output is effective, throwing or hitting a ball, manoeuvrability / faking-skills can be done effectively.

When the feet are in front (posture 1) or downward (posture 2) the trunk is balancing on the buttocks and upper legs. Without strapping, not a stabile position to do movements with the upper body. The position with the feet rearward, especially in tennis requires a knee-support to overcome the imbalance. The knee seat position however is extremely stable. The mass of the legs is brought toward the centre and the support is extended to a greater area; buttocks, calves and knees. The side-rails of the new RGK ATP knee seat sports wheelchair will lock up the upper legs.

The key however for the stability lies in the lock up of the pelvis. In the knee seat position the hamstrings are relaxed, allowing the pelvis to rotate forward. The quadriceps (especially the rectus femoris) are tightened, rotating the pelvis forward and are not hindered by the hamstrings. The pelvis, as the base of the spinal column, can't move in any direction in this forward orientation. This is why the knee seat posture is creating the most stable base for action of the trunk, shoulders and arms.

Arm-Trunk-Power / Acceleration

In the sitting posture 1 (feet in front) and 2 (feet under) the pelvis is rotated toward the rearward position. The lumbar spine is brought backwards, causing the spine to curve into the C-shape. This kyfotic posture is not an ideal posture for power transmission. For that reason tennis players place their feet as far rearward as possible, in order to create a forward rotation of both pelvic and spine. The knee seat posture can be seen as a further evolution of this feet rearward position.

In the knee seat position the pelvis is stable and has a forward orientation. The lumbar spine will follow that direction forward. Now it becomes possible to use the trunk into the propulsion. Besides the armpower we can also speak of trunk power. This trunk power consists of three factors: one is the weight of the trunk itself, which gives an extra propulsion. Secondly the gravity force on the trunk and third, if available, the contraction of the abdominal muscles. We can now truly speak of Arm-Trunk-Power (ATP) instead of Arm-Power only. As you can imagine, this ATP propulsion is more effective than the Arm-Power propulsion. The result is not only more propulsion power but, related to that, also a greater acceleration. This is an important factor while the sport actions are done frequently from a standing, not moving, position.

Reach

In tennis, badminton, basketball and hockey, it is important that the reach of the athlete is maximised. Tennis and badminton players need a maximum reach to be able to hit the ball / shuttle when it is far away from the wheelchair. They need the maximum power and acceleration to move towards the ball / shuttle and when they have the maximum reach they are able to finish with the most effective stroke. Also the basketball and hockey players can benefit from an extended reach to create a greater reach. The ATP knee seat posture does rotate the lumbar spine forward, causing an extension/ stretching of the spine. With the extended /stretched spine the reach for the ball is maximised in all directions, upwards, downwards, backwards, forwards and sideways.

Manoeuvrability

Manoeuvrability can be influenced by several factors. The more camber, the faster the rotation. The wheel position also has its influence; the more forward, the more manoeuvrable. At a certain forward placed wheel position however the chair will only ride on the anti tips instead of the front wheels, such running will detract from the performance.

The position of the body and body segments however has also a great influence on the manoeuvrability. When the legs/feet are in front or downward, the body segment weight is relatively far away from the vertical rotation axis causing a higher mass inertia which results in a lower manoeuvrability.

In the knee seat posture the mass is centered around the vertical rotation axis causing a lower mass inertia resulting in better rotation. Compare the dancer on ice with the arms extended with the same dancer who flexes the arms, resulting in a far greater rotating mass around the vertical axle. Together with the fixed/stable position of the pelvis and legs the result is a manoeuvrability which was never achieved before.

Conclusion

The ATP-knee seat sitting position can be seen as the evolution through the last two decades of sports wheelchair seating. The position of the feet changed through the years from forward, to vertically under, to rearward and, with a new type of sports wheelchair, tucked into the knee seat position. In this knee seat position the pelvis is rotated forward and stabilized in a fixed position. The advantages are numerous; maximum sitting stability, maximum propulsion and acceleration, maximum reach and maximum manoeuvrability. Of course, this posture can only be achieved when the athlete has enough flexibility in hips and knees.

Kees van Breukelen. M.D.
Technical director Double Performance.