

## В ПОМОЩЬ ПРАКТИКУЮЩЕМУ ВРАЧУ. ЛЕКЦИИ

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### Advancements for an approved component positioning in hip arthroplasty with navigation technique

J. Grifka

Orthopaedic Clinic for the University of Regensburg, Germany

*Total joint replacement is one of the most successful operative procedures in orthopaedics. Independently, which technique is used, we have to pay enormous attention to the correct positioning of the joint components. In order to match these demands, we transferred our imageless navigation technique, we are using since 2001 in knee arthroplasty for the use of knee navigation. While performing our micro-hip operation technique, we use the brainlab navigation equipment with rich-trackers on the pelvis and the thigh for a real time data acquisition without preoperative imaging technique like CT. We examined our developed new navigation technique in prospective randomized controlled trials. The placement of the components has been assessed by postoperative CT, which confirmed the accuracy of the component position. The navigation system allows us to measure leg length and offset with different head combinations, until we reach the desired free range of motion. Authors call this method «imageless-navigation-technique». The additional time for the operative procedure was approximately 10 minutes per operation. The advantage of our development is, that we achieved to get a technique which is easy to handle for the surgeon, who is concentrated on the operative procedure itself and not on the navigation system and which allows a save and an reliable procedure. Key words: total joint replacement, intraoperative navigation, endoprosthesis positioning, hip joint.*

*Эндопротезирование является одним из наиболее успешных хирургических вмешательств в ортопедии. Независимо от используемой хирургической техники необходимо уделять пристальное внимание правильной установке компонентов эндопротеза. Для выполнения данных требований авторы изменили разработанную ранее навигационную систему, которую использовали при эндопротезировании коленного сустава начиная с 2001 года. Во время «микро-тазобедренного» хирургического вмешательства применено навигационное оборудование, которое состояло из установленных на таз датчиков, осуществляющих сбор текущих данных без анализа предоперационной КТ. Эффективность данной методики проверена при проведении проспективных рандомизированных исследований. Положение установленных компонентов эндопротеза контролировали с помощью послеоперационной КТ, подтверждающей точность установки имплантата. После установки мерных шаблонов тазового и бедренного компонентов система позволяла измерять длину конечности и шейки эндопротеза при использовании различных типоразмеров его головки до момента достижения достаточного объема движений. Авторы назвали свой метод навигации «невизуализированной навигационной техникой». Ее применение увеличило время хирургического вмешательства на 10 мин. Основным преимуществом разработанной техники является легкость использования хирургом, который, как правило, в большей степени сконцентрирован на ходе хирургического вмешательства и не должен отвлекаться на навигационную систему. Ключевые слова: тотальное эндопротезирование, интраоперационная навигация, положение эндопротеза, тазобедренный сустав.*

**Key words:** total joint replacement, intraoperative navigation, endoprosthesis positioning, hip joint

Total joint replacement is one of the most successful operative procedures in orthopedics. The number of operations is increasing worldwide. Nevertheless we have to be aware of possible problems. Namely dislocation, increase material wear and limited range of motion. In order to improve the operative technique and enable faster mobilization of the patient, we developed a special operative procedure: micro-hip [1]

Independently, which technique is used, we have to pay enormous attention to the correct positioning of the joint components. In order to match these demands, we transferred our imageless navigation technique, we are using since 2001 in knee arthroplasty for the use of knee navigation.

The aim of navigation is a most accurate placement of the acetabula component and the femoral stem, thus

avoiding major biomechanical problems of THA. One severe problem is early dislocation [2–5]. Another one is impingement, leading to component wear and loosening as well as limited range of motion and pain [6, 7].

With the procedure we developed, we are following the concept of a «combined anteversion». Therefore we start with the preparation of the femur (femur-first-technique) and choose the position of the acetabular cup according to the concept of Widmer. He figured out, that acetabular anteversion and femur antetorsion should together have a combined anteversion of 37°. On the one hand our navigation technique is orientated according to patients individual bony anatomy, on the other hand we have to considered the intended containment of the acetabular cup of 70 % of the surface and we have to performed a soft tissue balancing, which enables an ideal functional component orientation, matching our aims of maximum range of motion, a reduced risk for postoperative wear, impingement and dislocation [8].

### Technical procedure

While performing our micro-hip operation technique, we use the brainlab navigation equipment with rich-trackers on the pelvis and the thigh for a real time data acquisition without preoperative imaging technique like CT. Thus our method is called imagefree- or imageless-navigation-technique. Thus acquiring anatomic data intraoperatively.

### Starting with the femur

Experienced hip surgeons know, that the final antetorsion of the femoral stem, especially increased antetorsion cannot be changed when fixing cementless stems. Just in the final, deep positioning of the stem it sometimes gets increased and distortion due to the individual anatomical contour of the proximal femur. This can create enormous instability problems if the surgeon has aimed at a strict anteversion of the cup of 15° or accidentally produced even more anteversion. In order to prevent anterior dislocation Widmer created his concept of combined antetorsion of 37°.

Only if the final antetorsion of the femur is known, the acetabular component can adjusted in appropriate combined antetorsion thus allowing an optimal articulation without risk of dislocation and impingement due to the component placement.

### Adjusted cup placement

Following the Widmer concept we have to modify Lewinnek «save-zone». The desired inclination of the cup stays at  $(40° \pm 10°)$  whereas the anteversion has strictly been chosen in consideration to the femoral stem antetorsion.

Of course we consider, that the cup placement has to be done in a way that the cup is sufficiently covered by bone ( $< 70\%$ ) and does not lead to a softtissue impingement especially of M. Psoas. This way of positioning of the cup is possible due to the navigation system with registrating the bony rim of the acetabulum and the deep central cavum (Fig. 1).

### Advantages of the three D-visualization

Having placed the trial components for stem and cup, the navigation system allows us to measure leg length and offset with different neck and head combinations, until we reach the desired free range of motion without impingement or dislocation. It is a further advantage of our micro-hip-technique, that the patient is positioned on the side and that the leg, we operate on, is completely free in moving in flexion, extension and rotation, so that we can test the critical motion, especially in extension external rotation and in flexion an innerrotation (Fig. 2).

### First results

We examined our developed new navigation technique in prospective randomized controlled trials [1, 8].

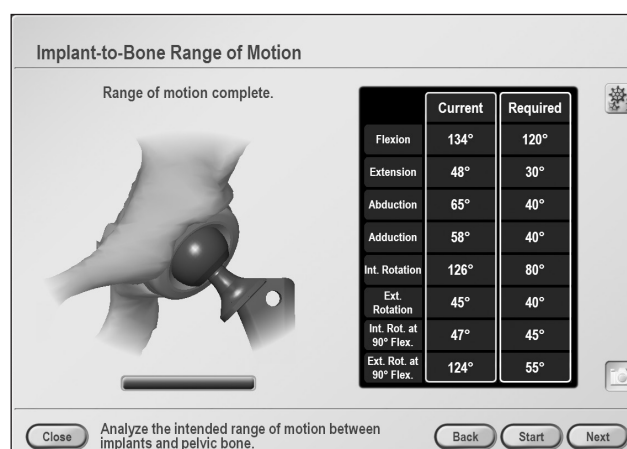


Fig. 1. Cup-placement with navigation system

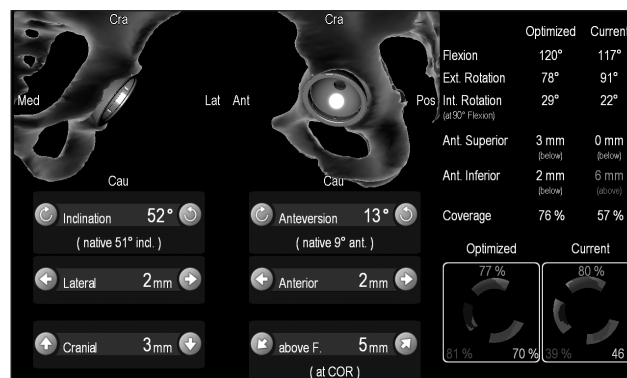


Fig. 2. Check of range of motion during intraoperative testing

The placement of the components has been assessed by postoperative CT, which confirmed the accuracy of the component position. In our study the additional time for the operative procedure was approximately 10 min per operation. We have seen the big advantages of combining the ideal neck-shaft angle for offset and leg length and the optimal matching of cup and stem.

We meanwhile perform this technique since five years. Quite a number of companies are now offering fist navigation systems for THA. The advantage of our development is, that we achieved to get a technique which is easy to handle for the surgeon, who is concentrated on the operative procedure itself and not on the navigation system and which allows a save and an reliable procedure.

**Conflict of interest.** The authors is involved in studys for De Puy Synthes and Brainlab.

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## ПРОГРЕСС В СОВЕРШЕНСТВОВАНИИ ВЕРИФИКАЦИИ ПОЛОЖЕНИЯ КОМПОНЕНТОВ ЭНДОПРОТЕЗА ТАЗОБЕДРЕННОГО СУСТАВА ПРИ ПОМОЩИ НАВИГАЦИОННОЙ ТЕХНИКИ

Грифка Дж.

Ортопедическая клиника университета Регенсбурга. Германия

✉ Joachim Grifka, MD, Prof.: [j.grifka@asklepois.com](mailto:j.grifka@asklepois.com)