Hand/wrist surgery

Use of the BV Pulsera with 3D-RX in hand/wrist surgery at the Academic Medical Center in Amsterdam

Who/where

Dr. S.D. Strackee, Plastic Surgeon, Department of Plastic Reconstructive and Hand Surgery

Academisch Medisch Centrum Amsterdam (AMC) The Netherlands

1000 bed university hospital in Amsterdam

Challenge

Evaluate the complex wrist joint and its pathology during surgery

Solution

BV Pulsera with 3D imaging

The AMC (Academisch Medisch Centrum) Amsterdam is a 1000-bed hospital in the south-eastern district of Amsterdam, the Netherlands, and includes the medical faculty of the University of Amsterdam. The hospital is a tertiary referral center for a wide range of specialties and clinical services. The services offered by the AMC include kidney dialysis and transplantation, radio-therapy, neurosurgery, neonatology and nuclear medicine. In addition to the specialized referral services, the AMC serves as a general hospital for South-East Amsterdam and the outlying districts. In the surgical departments (21 operating rooms), more than 100,000 operations are performed annually.

Dr. S.D. Strackee, a Plastic Surgeon in the Department of Plastic Reconstructive and Hand Surgery, has been working for more than a year with a prototype BV Pulsera C-arm system with 3D-RX. He specializes in hand/wrist surgery and has used intra-operative 3D in more than 40 cases to date.

Dr. Strackee: "3D is important for the assessment of complex structures such as the wrist, and shows things that cannot be seen in a normal radiograph. In our hospital it will be made mandatory in the context of good clinical practice. In complex cases we begin with a CT for planning purposes, but in less complex cases we can immediately begin with a 3D examination in the operating room."

Dr. S.D. Strackee, Plastic Surgeon,

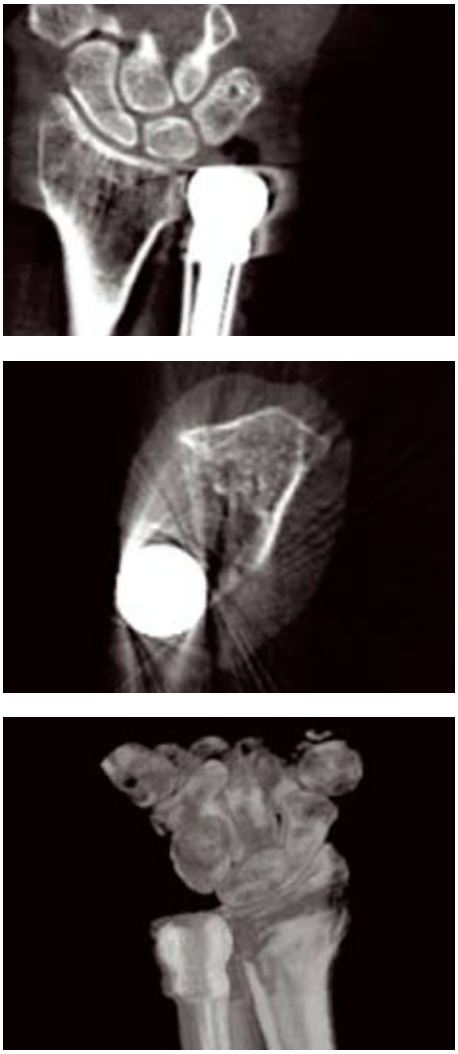
Conventional 2D fluoroscopy offers only limited possibilities for assessing the relative positions of bones and hardware. "3D-RX enables us to evaluate the complex wrist joint and its pathology during the operation using the planar reconstructions or a rendered image. Placement of pins, screws and plates can be evaluated by choosing different planes of reconstruction and by rotation of the 3D image. If necessary, repeated scans can be made after manipulation or surgery of the carpal bones. "

PHILIPS

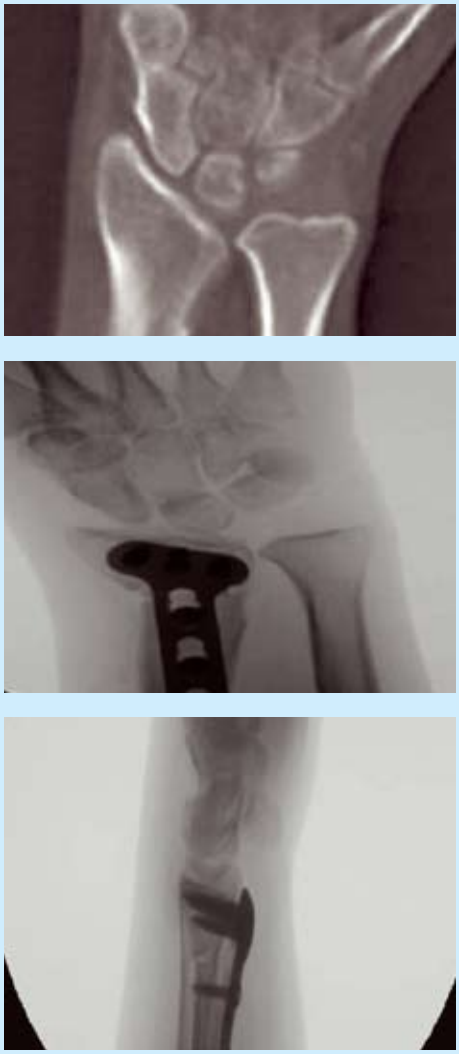
The placement of an ulnar head prosthesis is a relatively straightforward procedure. Assessment of the correct position of the prosthesis in a coronal (AP) view is not a problem with conventional fluoroscopy. However, it is not possible to obtain an axial view for assessing the position in the radial sigmoid notch, which is crucial for preventing dorsal dislocation of the new ulnar head. Despite the fact that an ulnar head prosthesis is made of solid steel, the 3D-RX images provide an accurate picture of the bony contour of the radius, with only marginal scattering.

In this example the position of the ulnar head prosthesis is too distal, so a correction is necessary to prevent ulno-carpal abutment. However the position in the sigmoid notch is correct. A rendered view of the wrist with the prosthesis in situ shows no scattering at all and can be used to assess the final result before closing the wound.

"3D-RX enables us to evaluate the complex wrist joint and its pathology during the operation"



ulnar head prosthesis

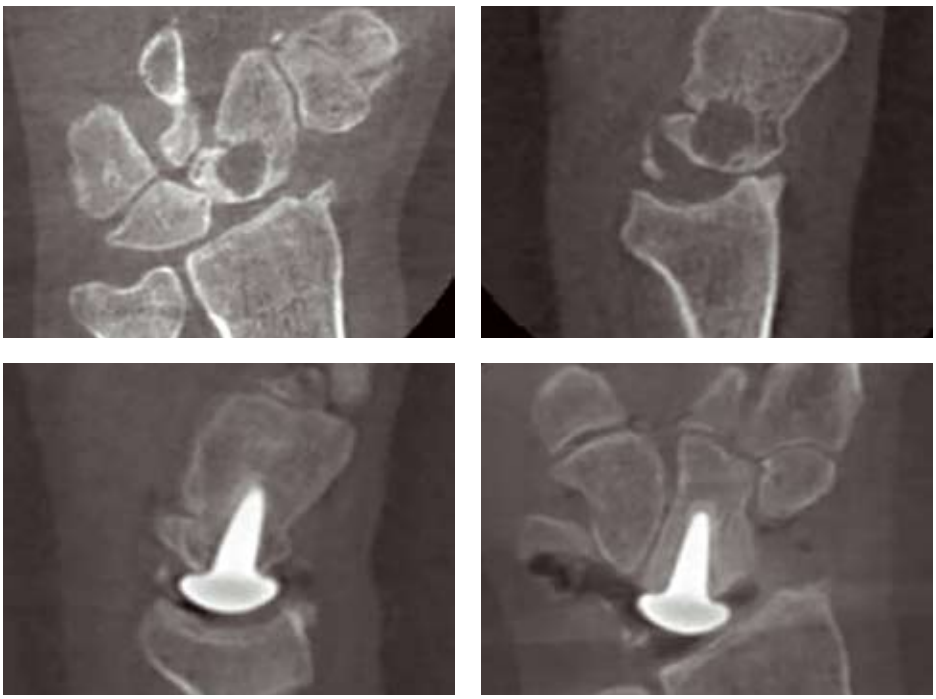


Madelung

Madelung's deformity is a radial deviation of the hand due to a growth disturbance of the ulno-palmar side of the distal radius with normal development of the ulna. The resulting ulno-palmar dislocation of the wrist and the protruding ulna leads to gross growth disturbance in the carpus and the distal radio-ulnar joint. The surgeon corrected this by cutting a wedge in the distal radius, rotating it and repositioning it at a slightly different angle. This can be planned very effectively using 3D imaging in the operating room. CT planning is sometimes excellent, but is difficult to match to the intra-operative situation in the operating room. With 3D imaging a marker can be placed on the dissected distal radial bone and the 3D examination can be performed with the marker in situ.
The surgeon can then compare the proposed level of reconstruction, to reassure that the position and angle of the cut are correct.

"3D shows things that cannot be seen on a normal radiograph"

The images show a case of a completely collapsed wrist following removal of a fractured scaphoid in a hospital elsewhere. There were only a limited number of possibilities for salvage without losing the ability to move the joint. Placement of a capitate prosthesis is a relatively simple procedure, but in this case where there is a large cyst in the base of the capitate bone, placement was critical. Prior to reaming the capitate bone, a cancellous bone graft was placed in the cyst. Without the ability to assess the positioning in different planes during the operation, it would be very difficult to obtain correct positioning of the stem of the coronal and sagittal slice of the same wrist after placement of a capitate prosthesis.



Coronal and sagittal slice of a collapsed wrist following removal of a scaphoid fracture. (top)

Analysis of the dynamic 3D movement of the carpal bones would be very beneficial for evaluating the function of the wrist. We have therefore started a research project into the 4D imaging (3D + time) of the wrist. In our method, the joint is moved in a cyclical movement by a motorized wrist support. This motion is synchronized to the X-ray acquisition in order to yield multiple sets of projection images, which are then reconstructed to provide a series of time-resolved 3D images, i.e. four-dimensional rotational X-ray (4D-RX) images. Dr. Strackee expects that this will pave the way to improved assessment of joint disorders by detection of abnormal 3D dynamic motion patterns in joints, and can also pinpoint the origin of pain.

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