2D-fluoroscopic based navigation for percutaneous screw fixation of glenoid fractures

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Introduction: Glenoid fractures are rare injuries and are predominently treated conservatively. Only in rare cases of articular fragments > 21% of surface, fracture-dislocations or as part of a double superior shoulder suspensory complex (SSSC) injury operative treatment with open reduction and internal fixation is recommended [1, 2].

Alternatively, technical demanding percutaneous and arthroscopic procedures are reported [3, 4].

Question: Is a 2D-fluoroscopic based navigation procedure applicable and useful for a percutaneous screw fixation of a glenoid fracture?

Materials & Methods: In a pretest the operating workflow was simulated to evaluate the best patient´s position on the operation table, the operating room set up and the fixation technique for the dynamic reference base.

Than a 2D-fluoroscopic based navigation procedure was used for the percutaneous screw fixation of glenoid fractures in two clinical cases:

1.) A 69 yrs. old woman with an unstable glenoid- (dorso-caudal articular fragment >30% of the glenoid) and humeral head fracture (Neer IV.4 part fracture fracture) after a fall on the right shoulder.

2.) A 28 yrs. old man with a SSSC-lesion (glenoid-, clavicular- and first rib fracture) after a motorcycle accident.

The associated injuries were treated in standard open operating techniques (humerus and clavicular locking plate fixation).

Results: The patients were placed in supine position on a 180° reversed standard operating table (Maquet) in a beach chair position. For the fixation of the dynamic reference base at the scapular spine and insertion of the screws via a posterior approach only the contralateral leg extension were used. The dynamic reference base was rigidly attached with a percutaneous two pin fixation or with a minimal invasive carbon-clamp fixation. Two fluoroscopic images of the shoulder (true anterior and y-view) were acquired for screw planning and navigated guide wire insertion (Vector Vision and Trauma 3.0 Software, BrainLAB). For the navigation specific registration procedure a new x-spot device was used, which facilitates faster image acquisition due to a reduced “in line of sight problem” without need for adjustments of the navigation camera dependent on the c-arm position. Using an autopilot function and the virtual visualization of the drill sleeve to navigate the drilling direction and the tip of the guide wire to control the drill depth, an optimized skin incision could be determined and the guide wires were placed percutaneously.

After verification of the guide wire positions with two additional fluoroscopic images, the cannulated screws were placed as lag screws. In the postoperative computed tomography anatomic fracture reductions and precise screw placements were observed.

Conclusion: The 2D-fluoroscopic based navigation is a promising approach for minimal invasive screw fixation of undisplaced, but unstable glenoid fractures. Especially for an oblique fracture pattern with a fracture line from antero-inferior to postero-superior the percutaneous screw fixation is possible only via a posterior approach. This procedure is demanding under conventional fluoroscopic control,

due to the long soft tissue path. To our knowledge, we report the first clinical cases of percutaneous screw placements in this direction, which is only described in an experimental study so far [4].

References

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