8 Injuries of the Upper Extremities

In automotive accidents, injuries to the upper extremities have probably received least of all attention compared to other body segments. This lack of interest can partly be explained by the fact that such injuries are generally not life-threatening. Nonetheless, they may cause long-term impairment associated with significant societal cost. Mainly the introduction of supplementary restraint systems, i.e. airbags, accounts for a regained interest in upper limb injuries. Due to their proximity to the upper limbs, side airbags were especially under scrutiny but also the effect of front airbags that deploy close to the hands and forearms is investigated. Furthermore, developments in airbag design, like depowered airbags, require current views to be constantly revised.

In contrast to the automotive environment, injuries to the upper extremities are common in sports and therefore received considerable attention. Various studies addressed the kinematics of the upper extremities in different motion patterns like throwing, a golf swing or a tennis stroke. Many studies can also be found on the diagnosis and treatment of upper extremity sports injuries. With respect to injury mechanisms, however, many questions remain unanswered and concerning injury criteria and injury threshold levels basically no conclusive literature is available.

8.1 Anatomy of the upper limbs

Generally, the upper extremities can be divided into four different parts: the shoulder (or shoulder girdle), the arm, the forearm and the hand. Figures 8.1 and 8.2 illustrate the corresponding bony structures.

The shoulder comprises scapula, clavicula and the joint articulations that attach the upper extremities to the torso. The arm is formed by the humerus and is linked to the shoulder by the shoulder joint which is probably the most mobile joint in the human body. The movement of the clavicula and
scapula allows translation of the shoulder in horizontal and frontal planes. Additionally rotations about the three anatomical axes are provided by the shoulder joint.

The elbow joint connects the arm to the forearm which consists of the ulna and the radius. A much simpler joint than the shoulder joint, the elbow joint allows flexion of the forearm towards the humerus, extension of the