Summery in English

Chapter one provides the reader with a general introduction into the field of peripheral nerve injury and neuropathic pain. Neuropathic pain is a complication seen after surgery and is more frequently seen in wrist surgery than anywhere else in the body. The complex anatomy around the wrist could be the reason. Also, the close topographical relation of the nerves in the wrist region makes them more susceptible to collateral sprouting.

Chapter two describes a newly discovered, clinically relevant pattern in the course of the Superficial Branch of the Radial nerve (SBRN). Knowledge of the complex SBRN anatomy is paramount in preventing iatrogenic damage during surgical reconstruction and recognizing (unintended) nerve damage after distal radius fractures, During the dissection of 20 embalmed cadaver arms recurring branching patterns could be identified. Furthermore, the point where the SBRN emerges from under the deep fascia was measured to Listers tubercle. The point at which the SBRN emerged from under the Brachioradialis muscle was consistently located at the distal 1/3 of the forearm Furthermore three distinct branching patterns of the SBRN were identified: Pattern 1 (N=10) and pattern 2 (N=5) were previously described in literature. In pattern 3 (N=5) two branches run a course to the radial and ulnar aspects of the thumb. The third and fourth branches run a course to the index finger and the fifth branch runs a course to the middle finger. Of the three branching patterns, two have been thoroughly described. The third pattern has only been described once and was found in 25% of cases compared to 5% in the previous study.

In **chapter three** the course of the Dorsal Branch of the Ulnar Nerve (DBUN) was studied in order to find recurring patterns. In twenty formalin-embalmed arms, the DBUN was dissected, the topographic relations were defined and they were categorized. Furthermore, the course in each arm was mapped. The point where the DBUN originates from the ulnar nerve in relation to the ulnar styloid process was measured. The distance between the origin of the DBUN in relation to the ulnar styloid process had a mean of 87.5 mm. The course of the DBUN varies greatly even between both arms of the same individual. The finding was compliant with current literature. However, in contrast to many studies, a radio-ulnar communicating branch (RUCB) was found in 80% of cases.

In **chapter four** the anatomical relationship between the SBRN and the Lateral Antebrachial Cutaneous Nerve (LABCN) was mapped using a newly developed technique. The SBRN is known for developing neuropathic pain syndromes after trauma. These pain syndromes can be hard to treat due to involvement of other nerves in the forearm. When a nerve is cut, the Schwann cells and also other cells in the distal segment of the transected nerve, produce Nerve Growth Factor (NGF) in the entire distal segment. If two nerves overlap anatomically, similar to the LABCN and SBRN, the increase of secretion of NGF, that is mediated by the injured nerve, results in binding to the high affinity NGF receptor, tyrosine kinase A (TrkA). This in turn leads to possible sprouting and morphological changes of uninjured fibers, that ultimately causes neuropathic pain. The course of the SBRN and the LABCN was studied using a new visual comparison technique called Computer Assisted

Surgical Anatomy Mapping (CASAM) and also the distance between the two nerves was measured at 5 mm increments. In 81% of measurements the distance between the nerves was less than 10 mm and in 49% the distance was even less than 5 mm. In 95% of the dissected arms the SBRN and LABCN intersected. On average they intersected 2.25 times. The close (anatomical) relationship between the LABCN and the SBRN can be seen as a factor in the explanation of persistent neuropathic pain in patients with traumatic or iatrogenic lesion of the SBRN or the LABCN.

Using the newly developed tool and the database used in the previous chapters, surgical techniques could be analyzed and improvements could be identified. In **chapter five** a case of unilateral scapho-trapezium fusion is described. Fusion of the metacarpal bones is one of the most common locations for bony fusion, however the fusion between the scaphoid and trapezoid has not been described this extensively before. Furthermore, the relationship between the fusion of the scaphoid and trapezium and disturbed hand kinematics is described. Finally, a suggested therapy strategy is started and the outcome was tested using patient outcome measures.

Chapter six compares the incision techniques for the surgical relief of Quervains disease (QD). QD was first described by Fritz de Quervain in 1895. Since that time many treatment options have been contemplated and used over the years. Treatment options nowadays vary from non-operative techniques, such as splinting and corticosteroid injections, to surgical technique. For the surgical techniques there are a number of possible incisions: transverse, longitudinal, lazy "s" and specific angle. All of the incision techniques can cause harm to the SBRN and in turn cause pain. The distance between the first two branches of the SBRN was 7,8mm at the beginning of the First Extensor Compartment (FEC) and 10,2mm at the end. Finally, the angle at which the chance of damage to the nerves is lowest is 19,4 degrees volar to the radius. In this study it was found that every technique has its pro's and con's. For beginning surgeons, the longitudinal and specific angle technique offer good exposure and less chance of iatrogenic nerve damage, however it is less esthetically acceptable compared to the transverse and lazy "S" techniques.

In **chapter seven** external fixation of distal radius fractures was studied. There are varying options in the treatment of distal radius fractures. These treatment options range from casting for simple and stable fractures to ORIF and external fixations in complex unstable fractures. Although many techniques have been developed for the surgical fixation of distal radius fractures, many surgeons still prefer the external fixation device because of its ease of use. A new proposed location for the Schanz pins in the third metacarpal was tested. Using the images created in CASAM as well as measurement between the SBRN and the second and third metacarpal. The distance between the nerve and the second metacarpal was much smaller than the distance between the nerve and the third metacarpal. Therefore, the third metacarpal was suggested as a safer place for Schanz pin placement. In the tests

performed in this study the nerve was not damaged by pins placed in the 3rd metacarpal. Further studies should evaluate the biomechanical strength of an external fixator placed in the second metacarpal compared to the third metacarpal, but considering form and tissue characteristics of both metacarpals, significant differences are not to be expected.

During the last decade wrist arthroscopy has been used more and more for therapeutic purposes and it is also often being performed by less experienced surgeons. Although reported complication rates are low, the use of new portals and less experienced surgeons could cause more damage than previously thought. In **Chapter eight** damage inflicted during a wrist arthroscopy workshop was quantified and recommendations were made. The SBRN, LABCN and DBUN were inspected for damage as well as the Radial and Ulnar arteries and the cephalic and basilic veins. Tendons and cartilage were also inspected. A large amount of damage and near misses were seen in the total of eighteen studied arms. Damage varied from vein damage to transection of nerves and piercing of tendons. The study shows that a total of more than three (near) injuries per arm could be seen during a wrist arthroscopy workshop. It is recommended that learning surgeons dissect their specimen after the arthroscopy workshop, in order to inspect possible damages, they have inflicted during the procedures.