Diplomarbeit

Tumors of the Hand — Is Our Surgery Reaching Patients' Expectations?

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Graz, 22.12.2016

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Ich erkläre ehrenwörtlich, dass ich die vorliegende Arbeit selbstständig und ohne fremde Hilfe verfasst habe, andere als die angegebenen Quellen nicht verwendet habe und die den benutzten Quellen wörtlich oder inhaltlich entnommenen Stellen als solche kenntlich gemacht habe.

Graz, am 22.12.2016 *Tobias Büchner eh*

Danksagung

Wie jede Blüte welkt und jede Jugend
Dem Alter weicht, blüht jede Lebensstufe,
Blüht jede Weisheit auch und jede Tugend
Zu ihrer Zeit und darf nicht ewig dauern.
Es muß das Herz bei jedem Lebensrufe
Bereit zum Abschied sein und Neubeginne,
Um sich in Tapferkeit und ohne Trauern
In andre, neue Bindungen zu geben.
Und jedem Anfang wohnt ein Zauber inne,
Der uns beschützt und der uns hilft, zu leben.

Hermann Hesse „Stufen“

Diese Arbeit repräsentiert zum einen das Ende einer Lebensphase und läutet zugleich eine neue ein. In diesem Sinn möchte ich mich bei all den Menschen bedanken, die mich während der vergangenen begleitet haben und mir in vielerlei Hinsicht beim Erreichen der nächsten beistanden.
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Zusammenfassung

Hintergrund: Die chirurgische Therapie ist im Fall einer tumorösen Veränderung im Bereich der Hand oder des Unterarmes meist unumgänglich. In diesem Zusammenhang galt es zu erörtern, in wie weit Chirurgie die Lebensqualität sowie die funktionelle Situation der Hände des Patienten beeinflusst. Bezüglich der postoperativen Lebensqualität von Tumorpatienten im Bereich der Hand oder des distalen Unterarmes gibt es derzeit wenig Daten.

Methoden: Wir führten eine retrospektive Analyse der Tumordatenbank und medizinischen Dokumentationen an der Universitätsklinik für Orthopädie und orthopädische Chirurgie des LKH Graz durch. An jeden der Patienten/innen (exklusive Ganglien-Fälle), die im Zeitraum vom Jänner 2004 bis zum März 2015 auf Grund eines Tumors an der Hand oder dem Unterarm operiert wurden, schickten wir einen Brief, bestehend aus dem SF 12 Fragebogen, dem DASH Fragebogen, und einem von uns aufgesetzten Fragebogen zu Themen der postoperativen Zufriedenheit, Lebensqualität sowie sozialen Parametern.

Ergebnisse: Von 125 wurden 49 Fragebögen (39,2%) retourniert. Unter diesen waren 55% Frauen und 45% Männer mit einem durchschnittlichen Alter von 54 Jahren (Im Bereich von: 22-84 Jahren). Maligne Tumore machten einen Anteil von 16,3% (n=8) aus. Die größte Einzelgruppe waren Riesenzelltumore der Sehnenscheiden mit 30,6% (n=16). Der mit SF 12 erhobene allgemeine Gesundheitszustand der Patienten belief sich auf 8% und 2% der Patienten, die ihren derzeitigen Gesundheitsstatus als weniger gut bzw. schlecht bezeichneten. Die durchschnittlich errechneten DASH-Werte lagen bei 25,8 für maligne, 9 für semi maligne und 7,5 für benigne Tumore (Mittelwert 11,26). Betreffend der sozialen Fragestellungen und des subjektiven Empfindens, fanden wir eine leichten negativen Trend (Spearman's Rho=-0.24, p=0.125) zwischen monatlichem Einkommen und den subjektiven Einschätzungen von physischer Einschränkung.

Schlussfolgerung: Die Mehrheit der Patienten sind mit dem Ergebnis der Operationen zufrieden. Eine höhere Malignität der Primärtumore korrespondiert, aufgrund der größeren

Invasivität der Eingriffe, mit einem schlechteren Ausgang für den Patienten. Zur weiteren Präzisierung in Patienten orientierter Outcome Evaluation in der Tumorchirurgie, müsste eine größere Kohorte, ein einheitlicheres Patientenklientel sowie zusätzliche Evaluationsinstrumete heran gezogen werden, um detailliertere Ergebnisse liefern zu können.

Abstract

Background: Surgical therapy is crucial for convalescence of patients and prevention of relapse, based on clinical and pathomorphological outcome parameters, in the majority of hand and distal forearm tumors. However, it remains to be elucidated how surgery impacts the patients' quality of life, as well as their hands' functional status. Regarding distal upper extremities affected by diverse tumor dignities, insufficient amount of data is available on the subject of determining post-operative health related quality of life.

Methods: We conducted a retrospective analysis of medical records and the tumor database at the Department of Orthopedics and Orthopedic Surgery, Medical University of Graz. All patients operated for hand or distal forearm tumors between January 2004 and March 2015 were included in our study. Study participants were sent three questionnaires: SF 12 questionnaire to determine the general health status, DASH (Disability of Arm Shoulder and Hand) to measure function and symptoms, and a questionnaire on social status and patients' personal pre-operative expectations and post-operative satisfaction.

Results: The response rate was 39.2%, i.e. 49 questionnaires out of 125 have been returned. Gender distribution was 55% women and 45% men, with an average age of 54 years (range: 22-84 years). The majority of tumor dignities present in the study population were Giant-Cell tumors of the tendon sheath with 30.6% (n=16). Malignant tumors represented 16.3% (n=8) of all tumor dignities. Regarding general health (SF 12), most patients were satisfied with their current health, only four and one of the patients estimated their health status as fair and poor, respectively. Overall DASH-Score was 11.26; Sub-analysis for tumor dignity showed an average DASH-Score 25.8 for malignant tumors, 9 in case of semi-malignant and 7.6 in the benign group. Regarding socioeconomic factors we found a trend to a weak negative correlation (Spearman's Rho=-0.24, p=0.125) between income and subjective restriction.

Conclusion: The majority of patients who underwent tumor surgery are satisfied with the outcome of the procedure. However, higher grade in malignancy results in a poorer outcome due to the higher invasivity of the operation. For further clarification regarding

patient related outcome measures in tumor surgery, a larger cohort with uniform baseline demographics, as well as additional outcome measures will be needed to achieve more detailed results.

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1. Introduction

The hand is one of the most recognizable parts of human body. We observe peoples´ working hands while doing tough work or nimble handcrafts or we purely admire the pretty hands of a ”hand model“ in an advert. Most peoples' hands nearly display their whole life story. With compassion we notice the lost finger of a craftsman, while standing in a bus or we observe the fine structure of a woman's hand holding her purse. The same goes with the less obvious details like little scars, broken nails and bad habits like biting ones nails. All this features are building up images of people and their lives. The focus on other people’s hands is even much more important in a private setting. We do not solely watch our faces while arguing or falling in love with each other. The positioning and movements of our hands often indicates our tension, our excitement or they just underline a blustering speech.

But beside watching them or underlining one’s speech argumentation or feelings we need our hands in every possible situation of our lives. Everything starts with our basic body functions — for example while we are eating. Since we lost the need to go out and hunt down our nourishment, we have to get them at the supermarket, where we need our hands to collect the things we like and put them into a basket, to empty it again at the checkout and then fumble out our purse and pay with some small metal coins which we would not be able to grab without fingernails. Back home our hands face new challenges waiting for them. After unlocking several doors, which normally involves using little keys, all packed on a tiny ring, we will finally arrive in our flat. Everything could be ready to eat. But sadly, civilization has forced us in some sort of habits called manners and behavior and we have to handle such inconvenient things like cooking and then preparing our favorite place of food consumption. All this work has to be performed by our hands using a variety of different tools which sometimes even endanger them.

What happens if we lose a specific function or even a whole hand? Many events in our lives may result in the loss of a functional structure or even an entire hand. After such an accident we will find ourselves in a fully different situation. All the things that have been normal, daily activities or work, might become seriously strenuous. Things like turning a key or opening a bottle might suddenly confront us as a demanding task. Apart from the pure functional problems there is also the psychological concern in a hand's failure. Even

worse than those private issues will be such a disability in everyday work. There are not many occupations which could be done by a person with serious failures of one's hands. Although it might not help an affected person with his or her personal approach to the loss of function, even insurances do put special attention on the hands different functional parts of their clients. When it comes to calculating the disability of a person who suffered from a disease in the hands or lost one or more fingers because of an accident, a high percentage is reached quite soon.

Moving focus to hand/forearm tumor patients, a loss in function can never be excluded. Having a tumor in the hand or distal forearm mostly leads to surgery in order to become disease free. Since the operation of a tumor occasionally includes the necessity of the removal of other anatomical structures nearby, some loss of function cannot be prevented. Therefore, the patients' outcome might differ from the expected or anticipated.

In cases where surgery has to be supported by chemotherapy and/or radiotherapy (1), which mostly requires a long hospital stay or at least a long-time interval until cure, postoperative patients' satisfaction might be even more difficult to reach.

Although tumor patients generally are treated by many physicians, dissatisfaction may never be excluded but improvement in patients' health outcome may often be achieved with effective physician-patient communication (2). Furthermore, it might also be a difference between a physician's satisfactory outcome and that of a patient.

Since modern medicine drastically improved cancer survival rate (3), patient related outcome measures became a highly important topic and groups like Geerse et al. have been evaluating the most relevant health related problems in cancer survivors (4). In this context, special attention has to be paid to childhood cancer survivors being at high risk for poor chronic health conditions (5).

Regarding distal upper extremities affected by diverse tumor dignities, insufficient amount of data is available on the subject of determining post-operative health related quality of life.

The aim of this study is the evaluation and comparison of our patients' clinical, functional, psychological and social outcome. Furthermore, we wanted to get an overview through our patients' basic satisfaction in regards of their overall opinion to our treatment and their expectations.

We hypothesized that a loss of function would be dependent on the diagnosis and patients' postoperative satisfaction would mainly be dependent of functional loss.

1.1 Anatomical Basics

We use our hands to get in touch with our environment, to communicate and even to interact with each other. To do so, the anatomy of our hands is the most complex of our entire musculoskeletal system. The human hand is built of 27 bones (not including the sesamoid bones) and its movability is controlled by a large number of extrinsic and intrinsic muscles, designed to serve us in a variety of situations.

The hand is basically structured into three parts, the carpus, the metacarpus and the phalanges.

The carpus with its eight carpal bones mainly represents the connection to the forearm through the wrist. Furthermore, it forms the carpal channel as a road for the median nerve and the flexor muscles of the fingers. At the dorsal site it provides the leading structures, the tendon compartments, for the extensors and the muscles of the thumb.

The metacarpus represents the region around the metacarpal bones whose palmar site is divided into the thenar, the hypothenar and the middle compartment. Only the middle compartment has a connection to the forearm through the carpal channel. The three parts are not connected to the dorsal site of the metacarpus and between each other, they are divided by strong septa. These facts underline, that swelling of the hand seldom occurs and pain mostly uses to be the first clinical sign of a pathology.

The fingers are specialized in being thin and flexible, they do not contain any muscular structures but different supporting structures to lead muscular tendons and forces.

The brachial artery splits into the ulnar and radial artery at the elbow level, reaching the hand through the Loge de Guyon and the Tabatière Anatomique, respectively. The two main arteries supplying the hand build anastomoses through the profound and superficial palmar arch. The arteries of the fingers and the thumb are released from them.

The nerves which supply the hands all arise from the brachial plexus. They are led to the hands through the carpal canal (median nerve) and the Loge de Guyon (ulnar nerve). The radial nerve already spreads into its final branches after reaching the cubital fossa and the superficial one reaches the hand together with the tendon of the EPB.

The sensible innervation of the skin of the human hand is also special and disproportionately well represented in the post central gyrus compared to other surfaces of our skin, which can be seen in the sensible homunculus.

The wrist is the connection to the forearm, an anatomical structure which in its complexity similar to the hand itself. The wrist is a composition of three different joints that are all supporting the positioning of our hand. From distal to proximal we first find the middle carpal joint between the two rows of the carpal bones, the radiocarpal joint as a connection between the proximal carpal row with the radius and the triangular discus and the distal radioulnar joint. The interaction of all these structures support a huge range of motion enabling an excursion of flexion and extension of about 90 degrees, ulnar abduction (40 degree) and radial abduction (20 degree). The distal radioulnar joint occupies an even more specific position in, together with its proximal counterpart, giving us the possibility of supination and pronation which however is supported by the interosseous membrane.

1.2 Benign and Malignant Tumors of the Hand

Tumors of the musculoskeletal tissues are seldom and tumors of the hand and forearm have an even smaller prevalence. In contrast to their rarity, there is a great diversity of dignities which can be found.

The basic classification is executed like in other parts of the human body. Musculoskeletal tumors are grouped in those arising from soft tissue and those originated from osseous structures. Both groups contain malignant as well as benign lesions (benign lesions representing 95% of tumors of the hand) (6), which themselves provide different grading. The malignant dignities may present with a high-grade as well as with a low-grade malignancy, which is determined by their histological growth and tendency to metastasize or infiltrate other tissues. Benign lesion may show locally aggressive growth and are thence called semi-malign tumors.

Another group is tumor like lesions; lesions which show the radiologic or clinical signs of a tumor without its actual patterns in growth.

Further classification is done in primary lesions and lesions of secondary origins (metastasis). Primary lesions describe the first appearance of a neoplasia, whereas

secondary lesions are returning after an allegedly cured disease or metastasizes from a primary lesion in a different body part.
Reviews have been analyzing prevalence of hand tumors and came to the conclusion that bony tumors are generally low in incidence whereas soft tissue and skin tumors can be seen more frequently (7,8).

1.3 Epidemiology and Etiology

Primary bony and soft tissue tumors of the musculoskeletal system only count 0.2–0.5% (9,10) of all tumors occurring in the human body. Regarding metastases, bones are the most common structures affected (11). Primary lesions appear mostly during childhood and until the end of material growth, while secondary lesions on the other hand are more likely to develop in older age. When turning focus on the area of the forearm and hand, it was shown that these structures are only affected in 19.8% of 3482 musculoskeletal tumor patients (12). The gender distribution of musculoskeletal tumors is minimally dominated by female patients (52%) (12).
The WHO is providing clinicians with a huge number of diagnosis and the classification, which is divided into subgroups according to the tissue the tumor arises from.
Regarding etiology, both bony and soft tissue tumors do not display any specific patterns. In some cases, genetic, environmental or viral factors have been found associated with the growth of a malignant or benign lesion but general conclusions have not been made (13).

1.4 Soft Tissue Tumors

Tumors of the soft tissue are among the more frequent lesions compared to bony dignities in today’s hand and plastic surgery. Although, most soft tissue tumors are of benign origin, clinical appearance often shows functional deficit and enlarging lesions are bringing patients to the physician (7). The following paragraphs will give an overview of some of the frequent soft tissue tumors that occurred in our study.

1.4.1 Giant Cell Tumor of the Tendon Sheath (GCTTS)

Giant-cell tumors of the tendon sheath are the second most common tumors found in the hands (14). It is a benign tumor which not necessarily has to grow in tendon sheaths and also does not always include giant cells.

It is slowly growing and usually affects the volar surface of the fingers, the palm or the DIP-joints (15). Some studies have shown that the tumor seems to prefer the dominant hand (16).

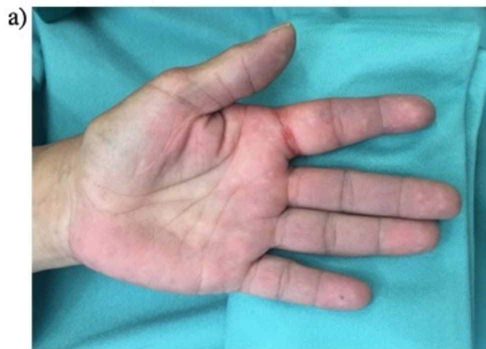
The clinical appearance differs. Patients often notice a nodular non-tender structure. If a peripheral nerve is affected, losses of sensory can be found as well, but invasion into the bone seldom happens. Diagnosis can be complicated by its sometimes atypical appearance in imaging diagnostics (14).

The treatment is mainly based on marginal excision which has to be executed carefully because of recurrence mostly being based on small satellite lesions and fragmentary surgery (17).

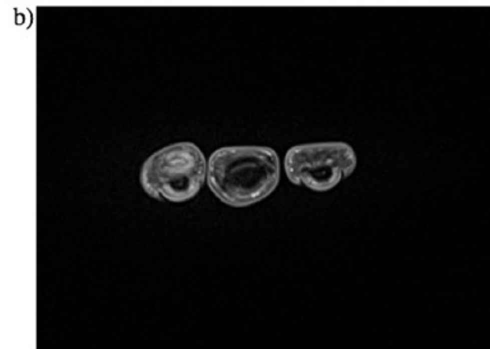
An issue with giant cell tumors of the tendon sheath seems to be its recurrence. Literature reports recurrence rates of about 14.8% (16) up to more than 40% (17) where some subtypes seem to reappear more often than others.

Fig. 1. Workup of a GCTTS

a)



b)

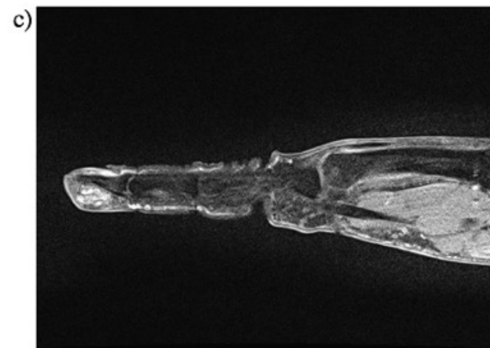


Intraoperative Images and MRI Scans of a GCTTS

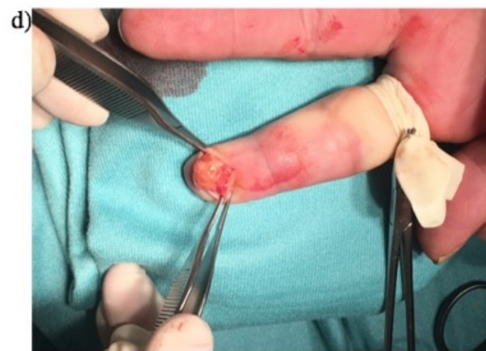
A 51 year old woman presented with a 1 cm non-tender palmar lesion of the distal phalanx. Ultrasound imaging did not show pathologic vascularization. MRI confirmed the diagnosis of a GCTTS. Marginal excision was performed.

a) Preoperative situation
b) + c) MR imaging
d) + e) Tumor excision
f) Macroscopic histology

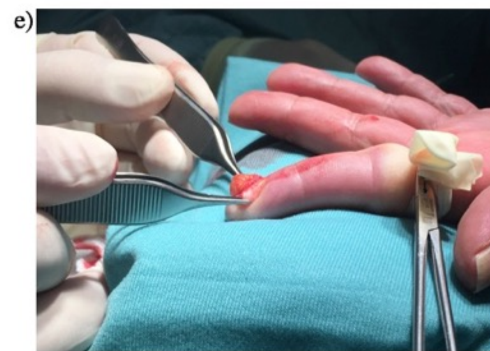
c)



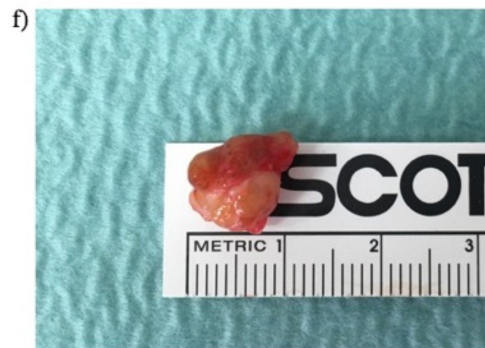
d)



e)



f)

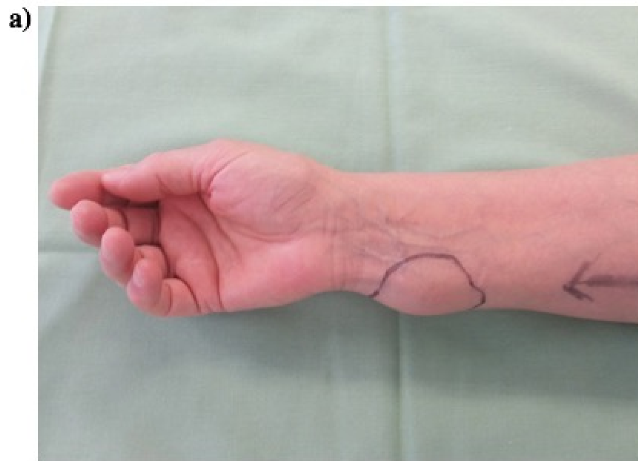


1.4.2 Schwannoma (Neurilemoma)

Schwannomas are the most common nerve tumors occurring in the upper limb and represent about 11.5% of all soft tissue tumors in the hand and forearm (18). It is a benign nerve tumor which evolves from the Schwann-cells and builds a restricted lesion in the peripheral nerve, where multiple lesions may occur (19).
Clinically we find a mostly painless mass on the flexor side of the forearm and hand with a size normally ranging between 1.5 and 3 cm (20). Neurological deficits are not common but radiations in the distal parts of the affected nerve can often be provoked as a Hoffmann-Tinel-Sign.
Its palpated structure is nearly the same as the one of a ganglion, what makes it more difficult to diagnose. The MRI imaging diagnosis might be complicated due to a Schwannoma's nearly identical morphology to neurofibromas or malignant peripheral nerve sheath tumors (21).
Surgical treatment is mostly done under microscopic magnification to prevent nerve lesions and post operative neurologic disorders. Recurrence of Schwannomas is seldom (18,22,23). Operations normally lead to a negative Hoffmann-Tinel-Sign and other symptoms like paraesthesia or sensory losses can be resolved in 70-90% of the patients, which argues for a positive outcome in most of the cases (20).

Fig. 2. Workup of a Schwannoma

a)

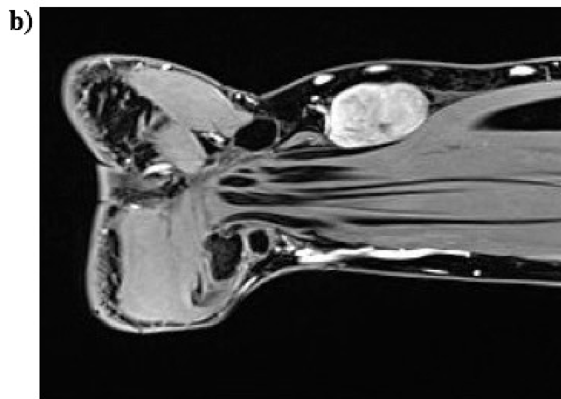


<u>Intraoperative Images and MRI Scans of a Schwannoma (Ulnar nerve)</u>

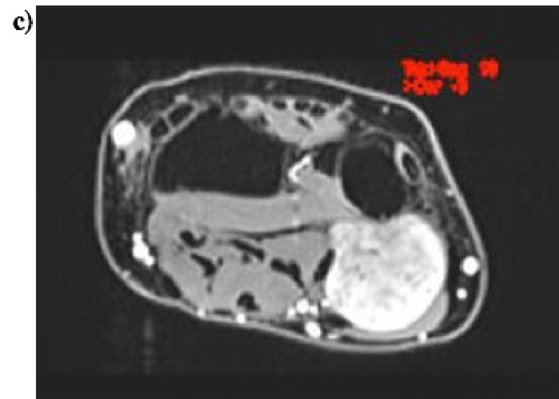
A 63 year old woman presented with a mobile, moderately tender mass proximal of the Ulnar styloid process, measuring 3x1.5 cm. X-Ray was normal. Ultrasound did not show pathologic vascularization. MRI confirmed the suspected diagnosis of a Schwannoma. Marginal excision was performed.

a) Preparation
b) + c) MR imaging
d) Tumor excision
e) Macroscopic histology

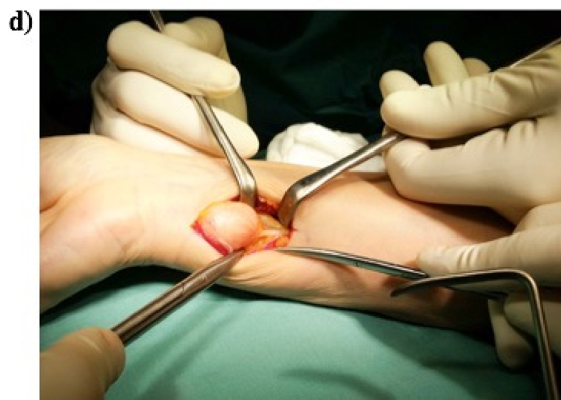
b)



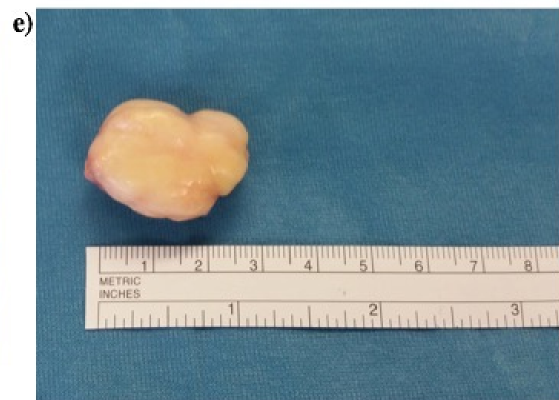
c)



d)



e)



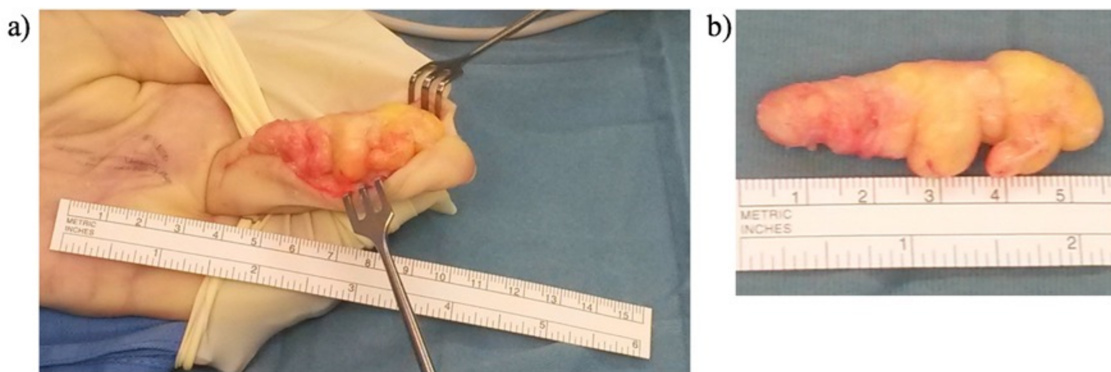
1.4.3 Lipoma

Lipomas are very common tumors occurring in the hand and may affect a variety of different locations with a higher incidence in obese people (10). Most commonly they will be found subcutaneously or intramuscularly sometimes even causing a carpal tunnel syndrome (23,24). Lipomas are soft masses which in radiographs show a soft tissue shadow in the affected area. Treatment of lipomas of the upper extremity consists of observation or operative therapy with marginal excision generally leading to a cured outcome and recurrence rates under 5% (7,22).

Fig. 3. Workup of a Lipoma

A 53 year old woman presented a lesion palmar of the 3rd digit with progressive growth over the course of five years. Neurovascular status was intact. MRI showed a lesion of 5.5x1.7x1.1 cm.

a) Tumor excision
b) Macroscopic histology



1.4.4 Glomus Tumor

Glomus tumors arise from the glomus body, an arteriovenous shunt regulating the blood flow and temperature in the fingers which are settled in the subungual area. In case of tumor growth, this angiomatous tissue starts swelling and produces intense pain under the nail. Another effect is an increased sensitivity to cold temperatures. Furthermore, the nail becomes extremely tender to pressure. Although Glomus tumors are generally considered benign, an atypical malignant growth rarely develops (25). Extradigital tumor growth is

rare but can for instance be found in the elbow (26). Since the tumor is usually not palpable, diagnosis can be verified with ultrasound or MRI showing a high T2 signal or uniform gadolinium enhancement (27,28,29).

Treatment is mainly based on surgical extraction of the sometimes multiple tumors to avoid recurrence (30).

1.4.5 Soft Tissue Sarcoma

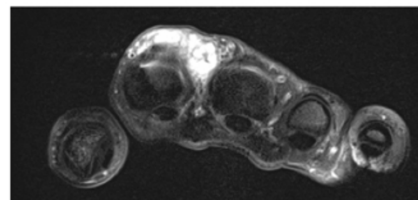
Soft tissue sarcomas are highly aggressive tumors based in the extra skeletal mesenchymal tissue with the upper limb being less frequently affected than other body parts. Only 15-25% of soft tissue sarcomas appear in the arms and hands (31).

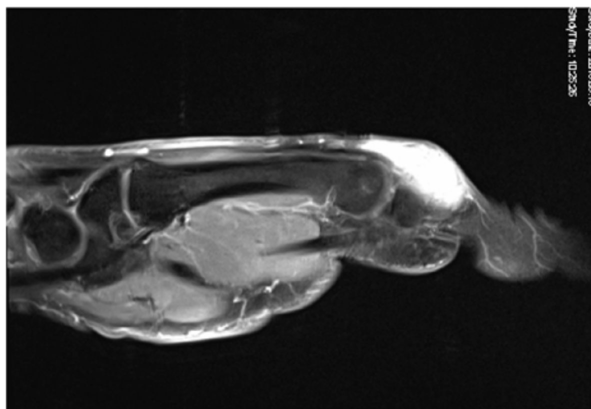
Diagnosis is based on MRI and pathological staging after open or needle biopsy.

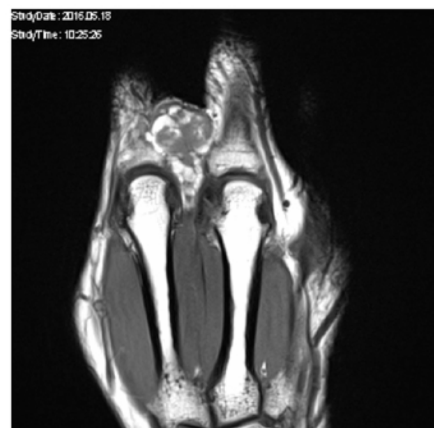
Surgical treatment used to be a radical resection which often lead to amputation of the hand or forearm because of traditional resection margins being 2-3cm. However, therapy today is based on advanced chemotherapy and radiotherapy to reach limb salvage (7). Additional to surgery, irradiation has shown an improvement in local tumor control and neoadjuvant irradiation also proved beneficial in cases of larger tumors (7).

Fig. 4. MRI scans of a Cutaneous digital papillary adenocarcinoma

Cutaneous digital papillary adenocarcinoma
A 40 year old man presented with a non-tender tumor dorsal to the metacarpophalangeal joint. Closure of fist was possible. Neurovascular status was intact. MRI showed a lesion of 3.5 cm in diameter with enhanced vascularization.







1.5 Bone Tumors

Only six percent of the bone tumors occur in the hands (32), the majority of which is benign. Generally, benign bone tumors are locally more aggressive in the hands than in other locations similar to giant-cell tumors for instance, whereas malignant bony tumors do vice versa (8). Symptoms like local swelling or chronic pain normally lead to clinical presentation.

1.5.1 Giant Cell Tumor

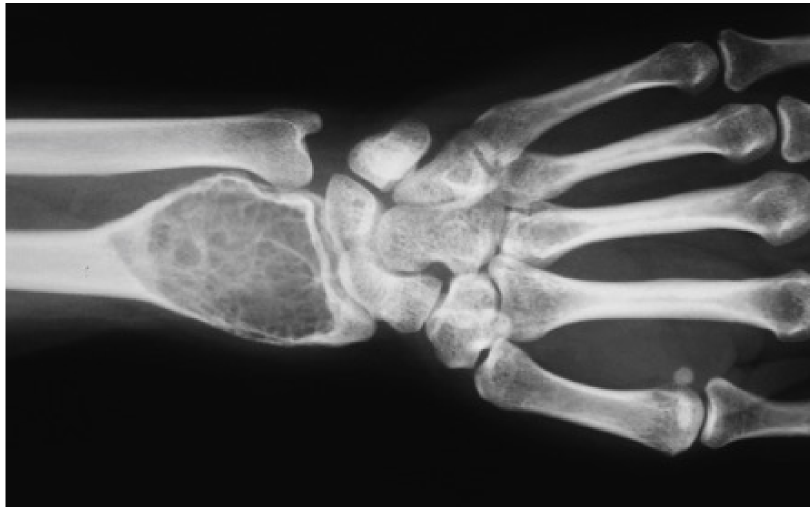
The giant-cell tumor is one of the most common bony tumor appearing in the human body, representing about 5% of all primary bone tumors (33) and up to 20% of all benign bone tumors. Although it is basically benign, it grows locally aggressive and might metastasize to the lung with an incidence of about 4 percent (different studies are showing incidences between 1% and 9%) (34).

Giant-cell tumors regularly grow in the epiphyseal parts of the long bones like the distal femur, the proximal humerus and the distal radius. Its appearance in the hands is rare.

In most cases, the tumor presents itself as a lytic lesion which can also affect nearby subchondral areas and surrounding soft tissue (35). Giant-cell tumors are commonly graded by the Campanacci-Score, which ranges from Grade I. (latent) through Grade II. (active) until Grade III. (aggressive) and is mainly based on radiographic appearance (36).

Because of a high recurrence rate (20%-50%) (37), treatment of giant-cell tumors is mostly invasive. Two of the main surgical methods are intralesional curettage followed by a refill with bone substitute, or resection with allografts from the tibia or fibula (38). Another approach has been currently evaluated by Wang et al., who studied the results of custom made unipolar wrist hemiarthroplasty in Grade III. giant-cell tumors of the distal radius (37).

Fig. 5. Giant-cell tumor of the distal radius



Our study included a variety of other tumor dignities which are not discussed, since it would exceed the idea of this work.

1.6 Treatment of Tumors in the Hand and Forearm

The main problem of tumors occurring in the hands is their rarity with the result that most surgeons encounter them irregularly (32). Furthermore, they often have uncommon growth patterns and their metastatic behavior also differs compared to the same tumor dignity in other body parts. In addition to that, the hand's special delicate anatomy and the resulting superficial position of many of the hand's tumors are confronting the surgeon with a much more complicated operation than in other structures. This is underlined by the fact of the large number of small nervous, vascular and functional structures located in the operational field or even being surrounded by the tumor. Nevertheless, treatment of hand tumors is generally based on the same principles as in other body parts: histological grading, surgical staging and the upcoming decision for the final resection or amputation are forming the procedure (39).

1.6.1 Anamnesis

Anamnesis of patients with tumors in the hands follows the same basic steps and hits as in other parts of the muscular skeletal system. Every fracture without any considerable trauma must be regarded as a pathologic fracture and therefore be examined. The same applies to chronic or subchronic localized swelling and pain. In the first place stands an anamnesis and a functional and physical examination including the volar and dorsal surface. This should be followed by exact and full examination of the radial, ulnar and median nerves (39).

1.6.2 Tumor Location

The most important part to the definition of a tumor's location is its proliferation through one or more compartments. If it is only growing in a single compartment, primary resection is mostly possible in a curative approach. When it already spreads through more than one compartment, treatment becomes a lot more difficult and prolonged.

What makes up an anatomical compartment? - Essentially, all tissues of the human body are restricted by a border to their neighboring structures. These borders are for instance the periosteum, muscular fascia or a tendon sheath which are building a relocatable stratum against other structures to guarantee movement. In case of a pathology they also confine a disease in a particular structure or compartment which helps stopping the spread of an infection or the growth of a neoplasm.

Imaging diagnostics used to visualize a tumors reach are mainly MRI and computed tomography.

1.6.3 Imaging Diagnostics

Today, we have a great variety of imaging diagnostic tools to use. All the different techniques give us the possibility of measuring the size of a lesion, let us estimate its borders and compartment and its impingement on other anatomical structures. Although, we may get loads of information from modern imaging it still does not provide us with a diagnosis.

Radiographs provide us with a high resolution picture of bones in all their detail. Surrounding soft tissue can be seen as well but in a less revealing manner. A full visualization of the region in question can be reached by taking a variety of pictures from different angles. The radiologic examination is mostly initiated with plain radiographs where bony tumors can be found with the obvious characteristics. Benign tumors mostly show cortical expansion with well defined borders, while malignancy is illustrated by cortical destruction, undefined borders and infiltration of the surrounding soft tissue. Plain radiographs are the basic and standard method to gain an impression of bony involvement in diseases.

Computed tomography offers a considerably bigger amount of information compared to the plain radiograph. The high resolution pictures produced by a CT provides us with a good option in localizing the spread of a tumor or to identify small tumors which have been invisible on a radiograph. Furthermore, the CT's ability in discriminating density variations allows an outstanding possibility in separating between the medullar canal, the cortex and the soft tissue which surrounds a bone. Additionally, CT is used to define infiltration and to give an expression of the bones architecture.

Bone scan provides us with the possibility of marking structures with specific metabolic processes to identify neoplasms, infections, trauma and metastases. Radioisotope scans are most useful in defining lesions which have not been identified in other imaging diagnostics.

MRI might probably be the most delicate and sophisticated option in diagnostic imaging. To generate a MRI study an electrical field is generated to cause atomic nuclear spin in x and y axis, simultaneously the energy of relaxation is recorded and assembled by a computer to form the final image. The final image can be used and looked at in different studies (T1/T2 weighted as an example for the most commonly used) to support tracing for pathologies. MRI is a superior imaging technique to assess soft tissues and therefore provides great help in planning of operational treatment.

Ultrasound which is based on the tissues variable reflection of ultrasound waves gives us a quick and radiation free realtime imaging. Compared to the previously mentioned methods its image quality leaks in resolution and is examiner dependent, but the technique is very inexpensive and provides us with useful information about smaller lesions and their growth in soft tissue.

1.6.4 Biopsy

The last stage in the diagnostic management is based on a biopsy and histology which normally provides the final key to the diagnosis (40). The aim of the procedure is to extract a tissue-sample to determine the dignity and malignancy of a tumor. Since every biopsy is an invasive operational treatment it requires the same amount of knowledge before the procedure as the final operation to avoid contamination of the tissue surrounding the biopsy tract (41).

Needle biopsy; although needle biopsy only produces a limited amount of useable tissue it is still used in hand surgery in cases of a recurrent tumor or a metastasis.

Open biopsy; open surgical biopsy is a method which is complex and difficult to plan, but plays a leading role in general musculoskeletal tumor surgery as well as in the surgical treatment of tumors of the hands (42). As most of the hand surgical operations, open biopsies are done in a bloodless operation field.

1.6.5 Classification and Staging

Staging describes the process of tumor classification with respect to extent and differentiation. Histologically, neoplasms are graded accordingly to their malignant characteristics after an open or needle biopsy (41).

The widely accepted and used grades (G) are the following:

-G0 = benign

-G1 = Low grade: few cells, much stroma, mature cells, less than five mitoses, little necrosis

-G2 = High grade: many cells, little stroma, immature cells, more than 10 mitoses, much necrosis

Furthermore, benign tumors are categorized into three different stages, based on their growth and local aggression.

In the latent stage (I) we find a not growing tumor which might heal without treatment or remains in the current state. Stage II is defined as an active growing neoplasm within natural borders, which can be controlled with intralesional excision or marginal excision. The third stage (III) presents itself as locally aggressive with a growth beyond natural barriers. Its excision requires a larger surgical margin to regain local cure.

Generally, the pathologist and the surgeon have to agree on the tumor grade before treatment (41).
Surgical staging is done as is shown in table 1.

Table 1.: Surgical Staging

Stage	Grade	Site
IA	Low (G1)	Intracompartmental (T1)
IB	Low (G1)	Extracompartmental (T1)
IIA	High (G2)	Intracompartmental (T1)
IIB	High (G2)	Extracompartmental (T2)
III	Any (G)	Any (T)
	+ Regional or distant metastasis	+ Regional or distant metastasis

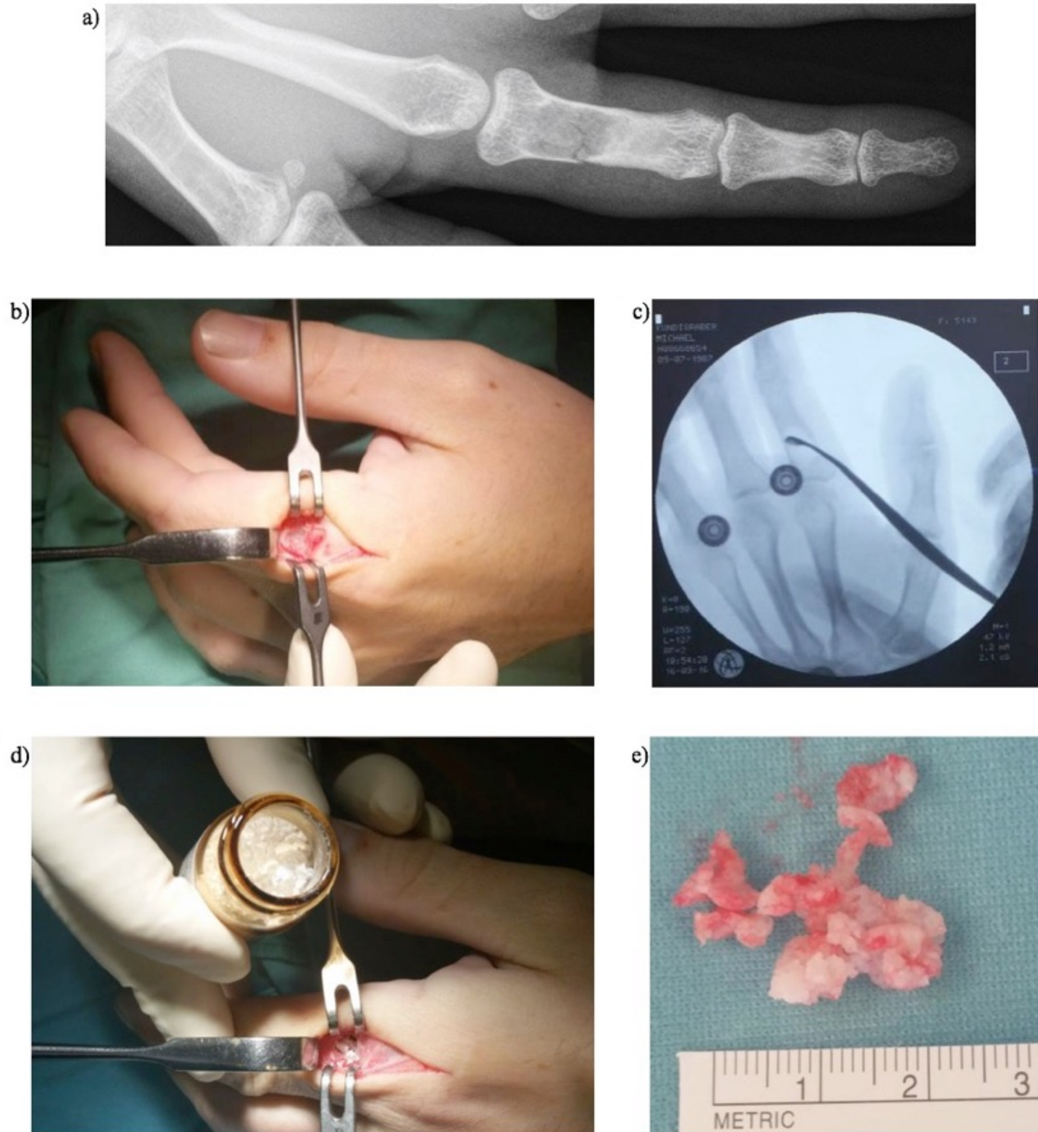
1.6.6 Surgical Treatment

Benign lesions are usually treated with a simple removal via curettage or with marginal operations. In case of concern about the need of a wide resection, a decision should be done according to a frozen histologically analyzed section.
Curettage is the standard procedure to treat giant cell tumors of the bone or enchondromas (35,43) where the resulting bone defect is filled up with an autograft or bone substitutes. If possible, the cortical cover is put back into place after the refill of the lesion. Because of its high recurrence rates (of 9-44%) (17) giant cell tumors are a challenging to treat and different approaches have to be evaluated in each specific case.
Intralesional resections, are tumor removals within the tumor’s capsule, leaving a microscopic residue which in the past was often associated with a significant rate of recurrence.
Marginal resection, is performed through or with removal of a tumors capsule, leaving microscopic residues. It can be seen as the basic principle in the treatment of giant cell tumors of the tendon sheath as well as in schwannomas.

Malignant lesions confront physicians with a more complex problem of wide excisions. As with all malignant lesions occurring in the human body, treatment has to follow after the definitive diagnosis. Furthermore, preservation of function has to succeed disease

eradication and survival. Fortunately, limb sparing surgery has been established and investigated during the last decades and new methods of radiotherapy, chemotherapy as well as neoadjuvant and adjuvant oncologic techniques have enabled the use of less radical methods and avoid amputation and therefore facilitate a much better functional and psychological outcome for the patients (44). A constantly challenging question is still left with the balance between the risk of unnecessary tissue loss and the need for adequate surgical resection margins mainly being depend of a tumors spread in a compartment and its ability to infiltrate new tissues. Malignant tumors are basically treated with a full removal of a whole compartment to reach convalescence. This could easily be achieved with a small locally growing bone tumor in a distal phalanx but in case of soft tissue sarcoma arising from a muscular structure of an extending muscle, amputation up to the elbow would be needed to remove the whole compartment (39). The necessity of such enormous operations is not proved uniformly for all compartments. In case of a dorsal muscular infiltration, extirpation of the fingers and/or the thumbs extensors has to be performed but is not necessary for the whole muscular compartment. To reconstruct functional structures as well as to reach a more pleasant looking outcome many surgical techniques are in use. The defect can be closed with a muscular free flap such as a gracilis flap with a final skin graft cover and function may be restored with different tendon grafts and transfers (45). Both functional and optical reconstruction methods need a lot of effort by the operating surgeon as well as by the patients' ability to follow exact postoperative regimes. If both are performed well, an excellent outcome may be resolved, but if the patient is not following important parts of the treatment, poor outcome can be the consequence (39,41).

Fig. 6. Workup of an Enchondroma



Intraoperative Images and X-Ray imaging of a Enchondroma

A 29 year old man presented with a fracture of the 2nd proximal phalanx after minor trauma. X-ray showed a cystic lesion. MRI showed an extensive lesion with arrosion of the radial cortical bone. Intralesional curettage was performed.

a) Plain X-ray
b) Curettage of the lesion
c) Intraoperative imaging
d) Filling with bone substitute
e) Macroscopic histology

2. Material and Methods

We conducted a retrospective analysis of the department's tumor database and hospital medical records to collect all patients who underwent surgical treatment at the hand or the distal forearm because of a tumor in the Department of Orthopedics and Orthopedic Surgery of the Medical University Graz. Due to the small number of tumors occurring in the hand or distal forearm we outlined the time period which we wanted to study within a timespan of ten years. In addition to that, we set a minimum time of follow up to one year after surgery. These specifications lead to a time period from 01.2004 until 03.2015. Furthermore, we excluded all ganglion cases and skin tumors to avoid a statistical dominance of these lesions. Patients with tumors occurring at or proximal to the elbow were also excluded.

After finishing analysis of hospital's data, we sent all the included patients a letter containing a form sheet about general agreement and three questionnaires we wanted to use. These were the general health questionnaire SF12, DASH (Disability of the Arm, Shoulder and Hand) to evaluate function and symptoms and a short questionnaire about social topics, postoperative satisfaction and personal expectations, which we wanted to ask about separately.

The final excluding criteria we set was non-response.

2.1 Questionnaires

Questionnaires working with health-related quality of life of patients (HRQOL) have become an important subject in modern day medicine. They are used in all different domains and modified constantly to provide the best useful results.

Furthermore, they might have helped integrating the bio-psychological relevance and social aspects into modern medicine.

Today we have the possibility to choose a questionnaire out of two groups. Firstly, there are generic tools which generally work out a patients health status without handling structural medical problems. In this group, we primarily find the SF12 and SF36 questionnaires.

Secondly, there are disease or domain specific measures, which are designed to specifically evaluate a body structure or the consequences of a disease's influence on patients. This group contains questionnaires like DASH or MSTS (46).

2.1.2 12-Item Short Form Survey (SF 12)

SF 12 represent the short form of the 36-Item Short Form Survey (SF 36) general health measuring questionnaire. It is a standard measurement to provide information about patients' daily life and basic health issues. These twelve questions concern the following topics:

1. General state of health; personal assessment of the current state of health
2. Influence of the patients' current health on daily life's physical activity
3. Influence of the patients' health on occupational or working activities
4. Influence of the patients' psychological health on daily life situations and personal efficiency
5. General psychological situation
6. Influence of the psychological situation on social activities

We selected SF12 with the idea of using a small tool to achieve basic health information without prolonging the time needed to answer our survey.

2.1.3 The DASH outcome measure

The DASH-score (Disabilities of the Arm, Shoulder and Hand) has been developed with the intention to get a score which would be less specific on a particular joint but still a special tool to handle the upper extremity (46). The aim was to produce a standardized outcome measure, able to work on a large variety of patients as well as diseases in order to improve uniformity and comparability between patients.

The actual version is based on a 30-item self report questionnaire working with different physical functions and symptoms of the upper limb. The first 21 questions consider the patients possibilities in using the hand/arm to do specific daily duties and tasks. The following nine focus on the patients' social and working restrictions as well as possible symptoms like pain, swelling and stiffness. These first 30 questions yield the DASH-Score,

which is calculated in dividing the total amount of points given by the patient by the number of answered questions.
This main part is followed by eight additional questions concerning the patients' abilities and limitations during her/his hobbies (playing music / sports) and work.
We chose to work with DASH, because of its great dissemination and wide acceptance. Furthermore, we wanted to use its variety in questions, especially in terms of different daily acts and its usability in the average population.

2.1.4 Our Own Questionnaire

Our own questionnaire consists of seven questions dealing with the patients' satisfaction after the operation and their expectations. Additionally, we wanted to evaluate our patients' social and financial status.
First of all, we wanted to know how our patients suffered from the operation regarding possible functional losses. To evaluate this topic we used the following two questions:
1. How far have you been restricted in the function of your arms and/or hands due to the operation?
2. How far does this restriction impact your daily life?
Both questions could be rated from 1-5 (1= not at all to 5=most intensive).
Secondly, we asked about the patients' expectations of surgery:
Does the condition after the operation match your previous expectations? It could be voted with: 1=yes, 2=I do not know and 3=no.
The following questions were dealing with social attributes. We wanted to know about our patients' job, last month's income and family status.
The final question was asking about the handedness.

2.2 Evaluation of Clinical Data

Our evaluation process started with the examination of the clinical tumor database. After eliminating all ganglion cases and setting the time period, we were left with 124 patients who underwent surgery for a benign or malignant lesion in their hand or distal forearm. The first step in evaluation was to control the correctness in diagnosis with the clinic's

Medocs database. Next, we worked out the variance of the cases to evaluate our patients distribution of age, gender, tumor dignity and time of follow up. The last part of our data collection was, integrating each patient's fundamental operational data into our database. Gender of the patients has not been taken into consideration, because there has not been any epidemiological result giving evidence that acral tumors of the upper extremity have an uneven gender distribution.

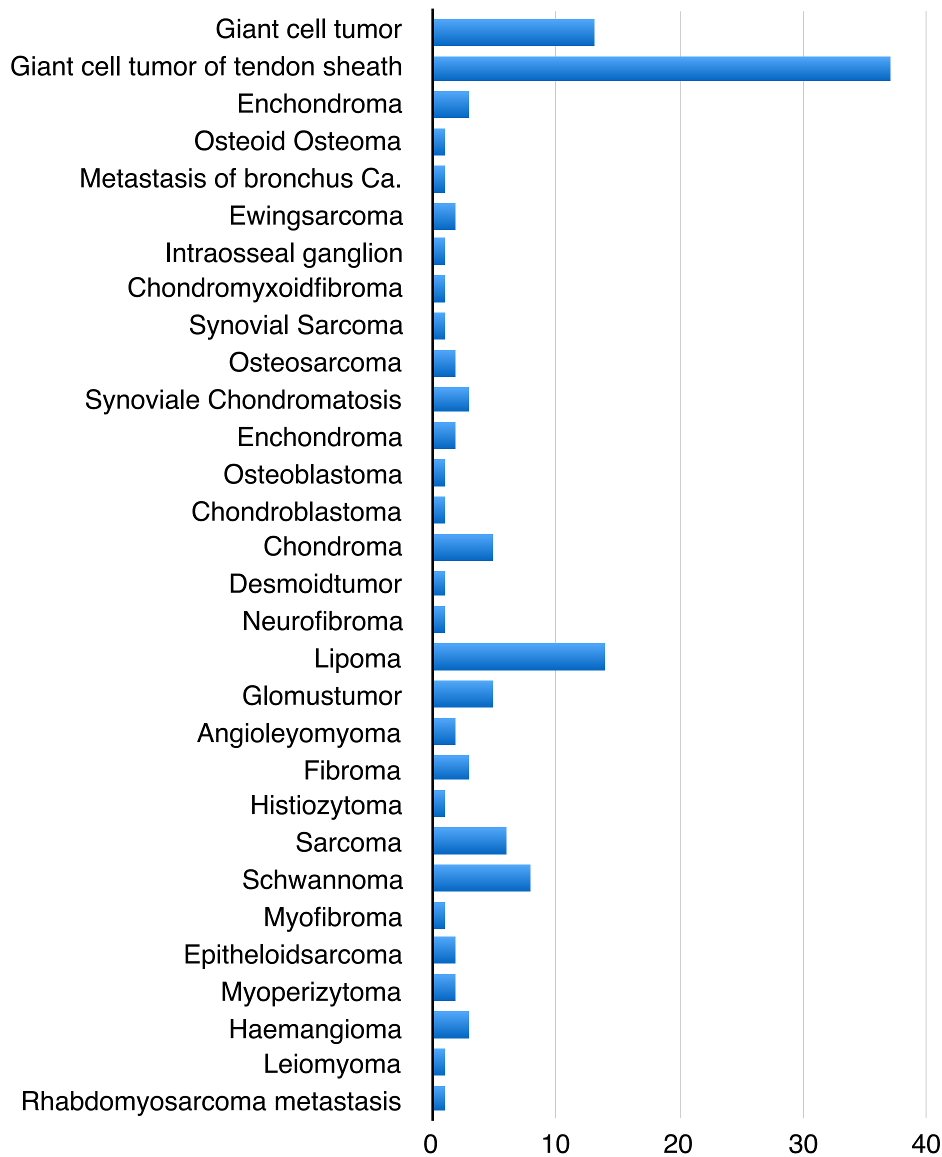
3. Results

3.1 Tumor dignities and baseline demographics after database evaluation

The tumor dignities we integrated have been various. Nearly all of our patients' lesions have been primary (90%). With 5% of the study population, secondary lesions represented a small proportion. The remaining five percent were composed of tumor like lesion (at the time of the first diagnosis), potentially malign tumors as well as a recurrence of a malign primary tumor. One bronchus carcinoma metastasis has been included because of those being a common secondary malignant lesion in hands (47).
The group of the primary lesions divides into 78 percent benign and 12,2 percent malign tumors. Since we did not include skin tumors we received completely different numbers compared to Marty et al. (48) who found a 1.3% prevalence of malignant lesions.
Giant cell tumors of the tendon sheath with a total number of 37 (29.8%) has been the most common lesion. The second largest groups were represented by lipomas with 14 patients (11.3%) and giant cell tumors with 13 patients (10.5%). Schwannomas were found within 9 patients (7.3%). The biggest malignant group were sarcomas of different origins with 9 patients (7.3%). The remaining 33.8% distribute in smaller groups where Glomustumors (five patients) created another mentionable group.
Our data showed a distribution of 41% men and 59% women. Studies of the prevalence musculoskeletal tumors concerning the whole body have reached similar data, coming up with a distribution of 45% male and 55% women (49) respectively 48% men and 52% women (12).
Concerning the age of our patients we found an average age at the time of the treatment of 48,4 years, the youngest person being 7 and the oldest 84 years old.

After the returning of the questionnaires, our demographics have changed slightly. We still had a gender distribution of 55.1% women and 44.9% men, while the average age increased to 54.7 years, the oldest being a 84 year old lady and the youngest participant being 22 years old.

Fig. 7.: All diagnoses after database evaluation



3.2 Tumor Localizations and Dignities of Our Survey

The table on the following page and the picture underneath are giving an overview of the distribution of the different tumor dignities and their localizations of the participants. The marks are representing the dignities in color and their sizes correspond to the number of tumors we found in a definite location (varying between 1 and 3).

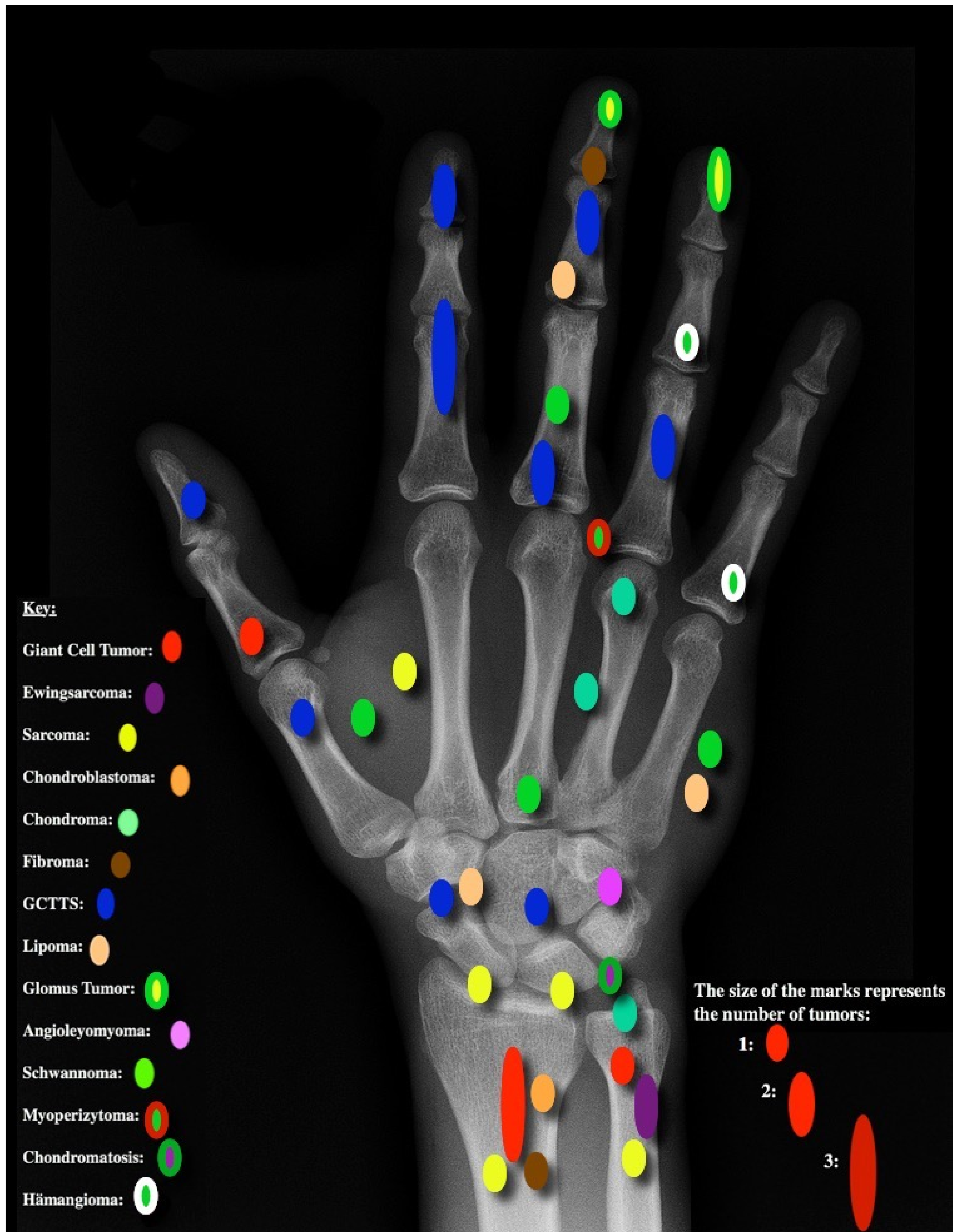
In case of the malignant tumors we found an accumulation in the distal bones of the forearm, the carpal joint and the carpal/metacarpal area. The fingers have not been affected

by any malignant tumor. Semi malignant tumors (giant cell tumors and one case of a myoperizytoma), also appeared in the fingers, leaving a gap in their spreading between the forearm and the digits. The benign group, with its greatest group represented by GCTTS´s, was disseminated through the whole area affecting the forearm, the hand joint, the carpus and the fingers.

Table 2.: Tumor dignities and count at each location

Dignity	Count	%	% before return	Locations
Osteosarcoma	2	4.1	1.6	Radius
Ewing Sarcoma	2	4.1	1.6	Ulna
Synovial Sarcoma	1	2	0.8	Radius
Epitheloid Sarcoma	1	2	0.8	Palm
Pleomorph undifferentiated S	1	2	0.8	Dorsal surface of the hand
Myxoinflammatoric Sarkoma	1	2	0.8	Wrist
Giant Cell Tumor	5	10.2	10.4	Radius, Ulna, Thumb
Myoperizytoma	1	2	1.6	Palm
GCTTS	15	30.6	29.6	No appearance in the forearm
Schwannoma	4	8.2	6.4	Metacarpal area / Digit III
Chondroma	3	6.1	4	Metacarpal area / Ulna
Lipoma	3	6.1	11.4	Carpal- Metacarpal area / Digit III
Fibroma	2	4.1	2.4	Radius / distal phalanx II
Haemangioma	2	4.1	2.4	Digits IV / V
Glomus Tumor	2	4.1	4	Digits III / IV
Chondroblastoma	1	2	0.8	Radius
Angioleyomyoma	1	2	1.6	Carpal area
Chondromatosis	1	2	2.4	Wrist

Fig. 8.: Tumor localizations of the survey (returned questionnaires)

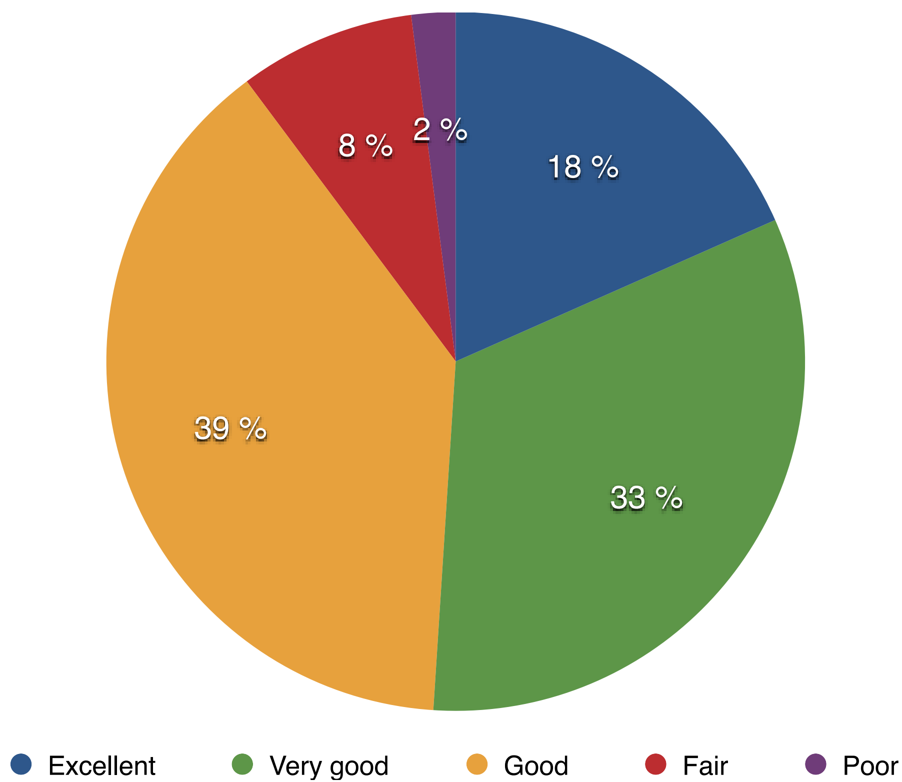


3.3 Evaluation of the SF 12 Questionnaire

3.3.1 General State of Health

Our patients' description of their general state of health has been mainly positive. Ninety percent rated their general health state with "good" to "excellent". Only ten percent of the patients have not been satisfied with their health at the time of our survey.

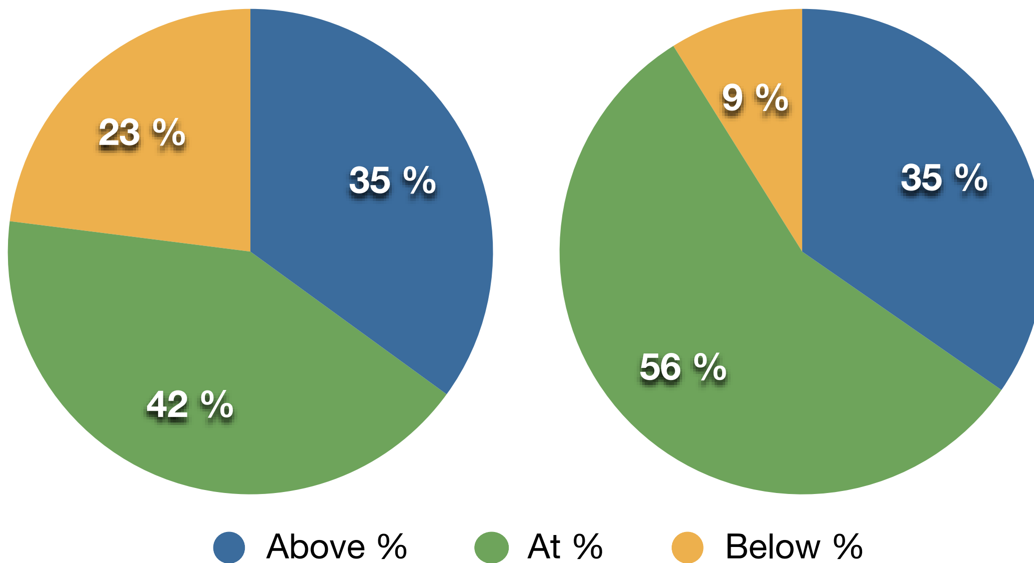
Fig. 9.: General State of Health



3.3.2 Physical Health Summary

The results of the physical health summary in SF 12 are based on four questions working with everyday activities and manual labor in a private and professional setting. These four questions are rated and compared to a general population and adjusted in age, to describe if patients of a survey are set above, at or below a defined general physical health state. The pie charts underneath show the distribution in these three groups divided for women and men.

Fig. 10.: Physical health summary (Female) — left
Fig. 11.: Physical health summary (Male) — right



Generally, both men and women showed a similar proportion of 35% being above the general state of physical health. The group of patients reaching an average physical health-state splits between women (42%) and men (56%).
Accordingly, we found just 9% of men and 23% of our female participants to be below the physical state of health by contrast with a control group of their age.

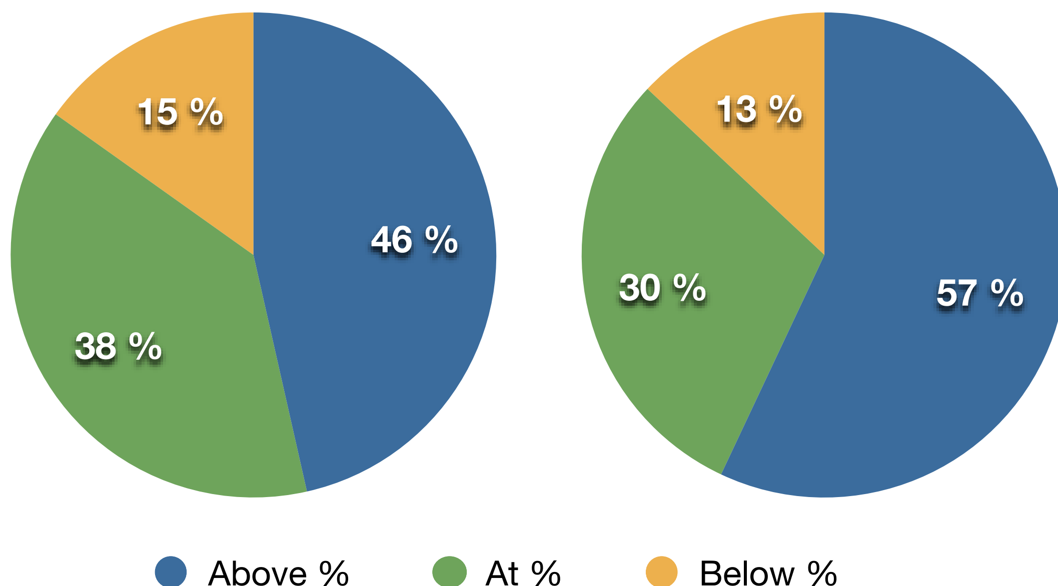
3.3.3 Mental State of Health

Concerning the mental state of health, SF 12 also uses a rating system which, similar to the physical health summary, combines the psychological questions from the survey and relates the answers to a set general population. Consequently, groups are divided correspondingly to the charts above (above, at and below the general mental state of health).

The following pie charts show this distribution in three groups, again divided into women and men.

Both women and men are showing a high percentage in the ”above“ and ”at“ category of general mental health state. The male participants are represented with 57% above the general mental state, women of our study were near the 50% mark, respectively (46% above the average state). Only 15% (female) and 13% (male) participants were found to be below an average mental health-state.

Fig. 12.: Mental health summary (Female) — left
Fig. 13.: Mental health summary (Male) — right



The essentially positive outcome in the mental health summaries can be supported and explained by depicting some of the results of the specific questions.

The Question: ”During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as

feeling depressed or anxious)? - Accomplished less than you would like… Yes/No“. This question was answered with ”No“ by 90% of the participants.

Almost the same outcome was obtained with the following question about the psychological influence on accuracy in daily life (”During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems? - I have worked or did other activities less carefully than usual… Yes/No“). Only six participants answered this question with ”Yes“.

3.3.4 Risk for Depression

SF 12 also provides the possibility of preparing a basic depression screening based on the answers given to the questions dealing with psychological problems and the patients' age, comparing the conclusion to a norm population similar to the mental and physical health summaries above.

When applied to our survey, it showed positive results for both women and men. Women only show a 15% risk for depression, compared to the norm population with a risk of 22%. Our male samples showed 0% of risk for developing a depression.

Fig. 14.: First stage positive depression screening: % at Risk (female)

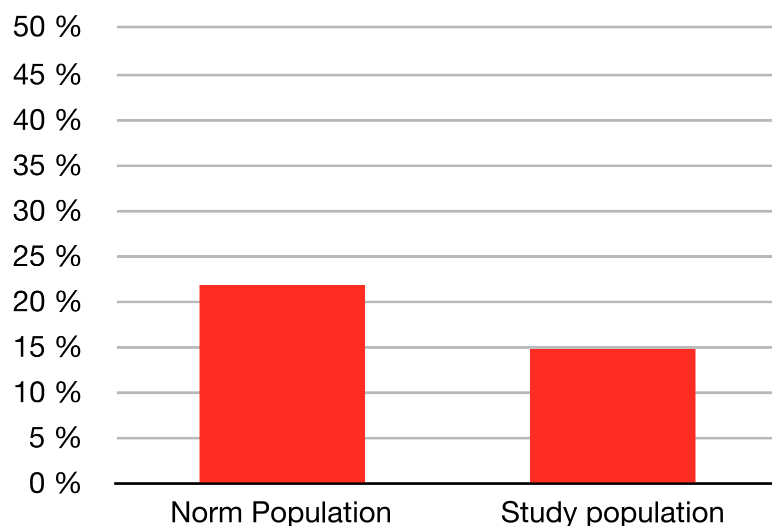
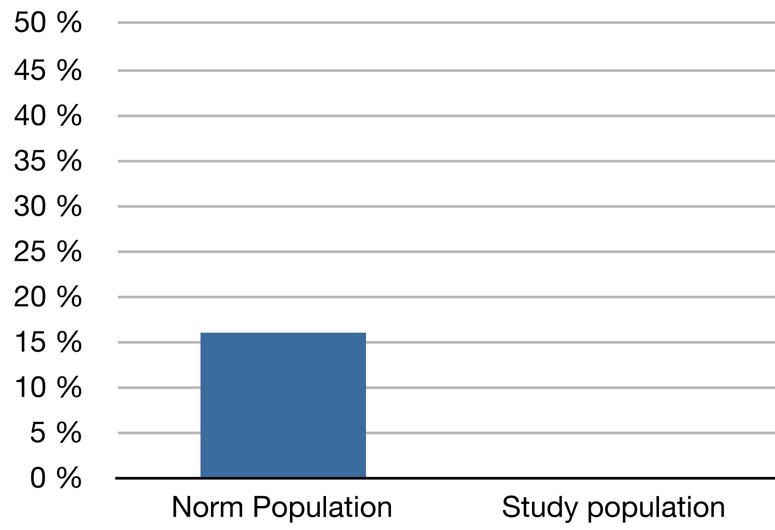


Fig. 15.: First stage positive depression screening: % at Risk Male



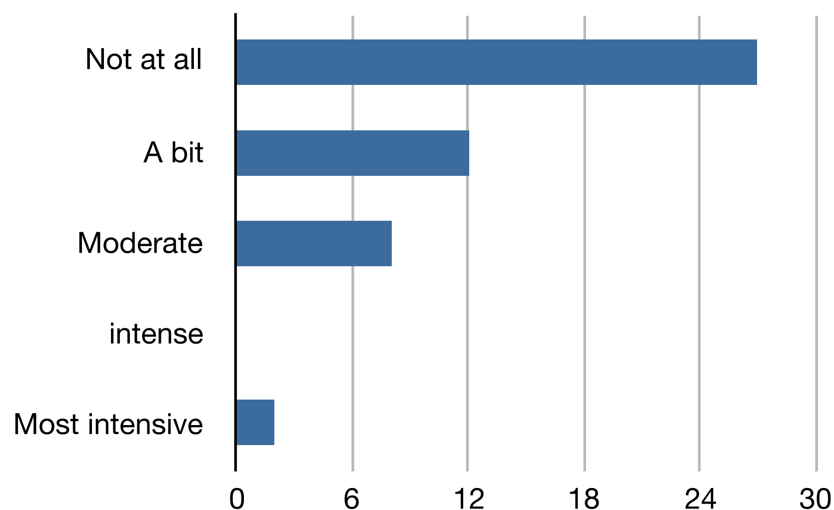
3.4 Evaluation of our Own Questionnaire

3.4.1 Restriction in Function Due to the Operation

The first question of our own questionnaire was: How much have you been restricted in the function of your arm and/or hand in consequence to the operation? The possible answers ranged between 1= not at all and 5=most intensive.

More than half of our patients (55,1%) answered the questions with ”not at all“. Twelve participants stated to be ”a bit“ restricted and 8 to have ”moderate“ restrictions after the operation. Only two persons declared that they feel most intensively restricted as a result of the operation’s outcome. One of them underwent a high brachial amputation due to a synovial sarcoma and the second participant underwent complex surgery including resection of the extending tendons 3, 4, and 5 as well as the ECRL tendon with allograft from the palmaris longus.

Fig. 16.: Restriction in function due to the operation



3.4.2 Influence of the Surgery’s Outcome on Daily Life

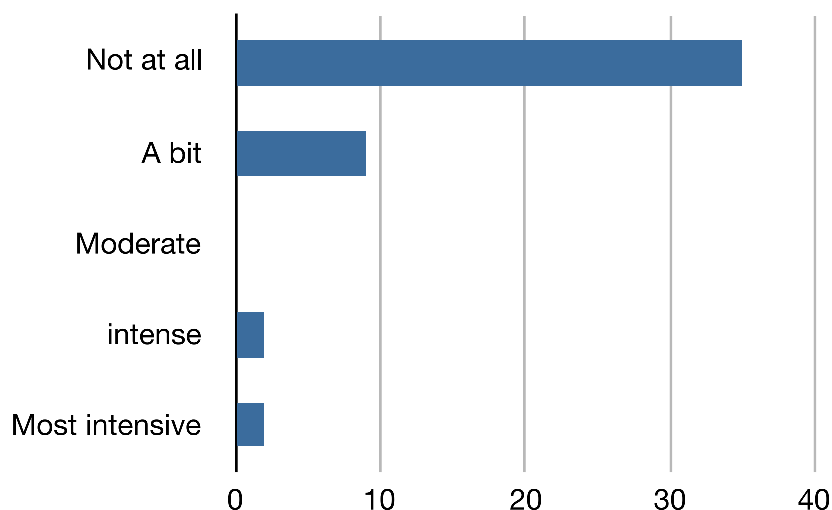
The second question was posed to evaluate the influence of possible restrictions resulting from the operation’s outcome on personal daily routine. (How far does this restriction

impacts on your daily life?) The same rating scale was used (1= not at all until 5=most intensive).

The second question yielded nearly similar results as the first. 81.65% (n=35) of our patients did not feel influenced in their daily life and 18.4% (n=9) had the feeling of having lost ”a bit“ of their life quality due to the operation. No-one in the group felt a moderate functional loss and only four persons answered that they had an ”intense“ (4%) or ”most intensive“ (4%) functional deficit, wherein the two participants stating ”most intensive“ deficiencies, both sarcoma patients mentioned before in the last paragraph. The former two declaring ”intensive“ functional losses are one case of a giant cell tumor in the distal radius, which was treated with a plate after pathological fracture, and one case of a palmar GCTTS, respectively.

In case of this question we got one drop out not answering it.

Fig. 17.: Influence of functional loss on life quality



3.4.3 Expected Outcome after the Operation

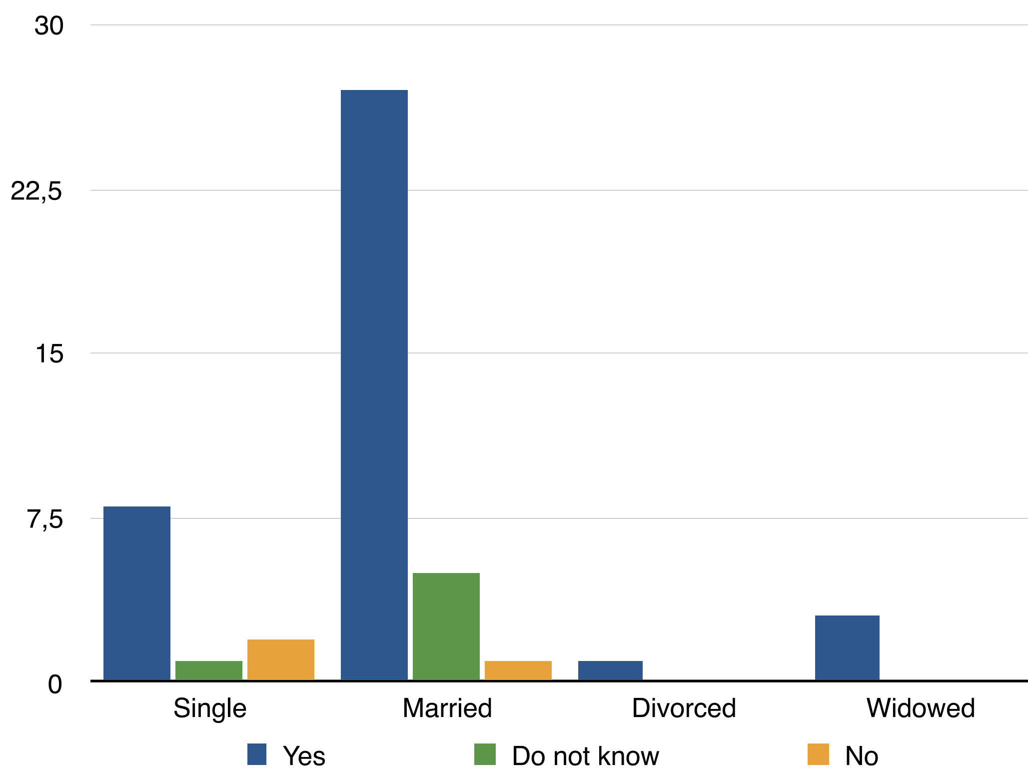
The third question we posed was asking about the patients’ expectations of the operation. We wanted to know if our preoperative work was sufficiently detailed enough to prepare our patients on possible outcomes as well as an idea of the participants’ extend of satisfaction.

To evaluate this fact we asked the following question: ”Does the condition after the operation match your previous expectations?“ It could be voted with: 1=yes, 2=I do not know and 3=no.

More than 80% (n=40) of the participants had the opinion, that the final outcome matched their previous expectations. Three responded with ”No“ and six with ”I do not know“.

The ”No-responses“ have all been made by patients who underwent more invasive operations, including tendon grafts and exchange plasty. The six persons having answered the question with: ”I do not know“ underwent their operations within the whole time period and might therefore not be explained with a long bygone intervention. The following figure shows the distribution of answers according to family status.

Fig. 18.: Expected Outcome / Family status



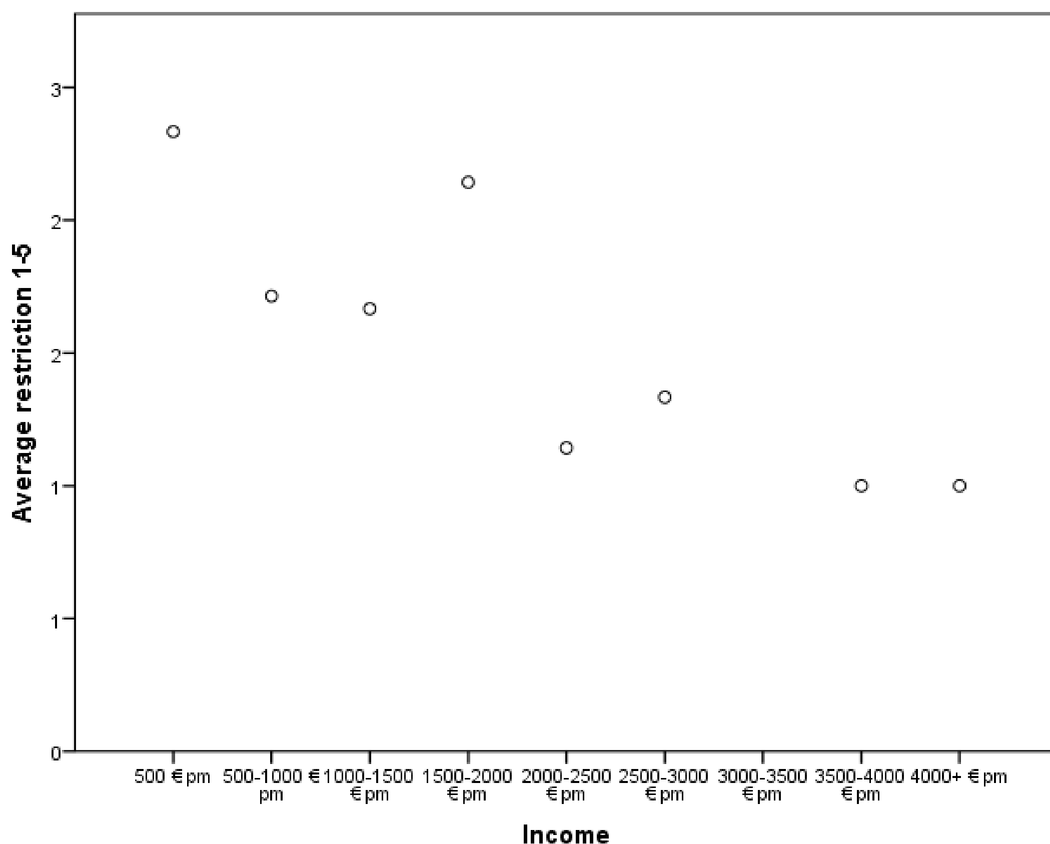
3.4.4 Social Parameters

To achieve some basic information about the socioeconomic situation of our participants we asked three questions concerning family status, current income and occupation.
Concerning the family status we got 69% married, 23% single, 2% divorced and 6% widowed. Regarding income, we found a slight dominance in the low groups which was the consequence of 19 of our participants being a pensioner at the time of the survey.

3.4.5 Income in Relation to Subjective Outcome in Restriction and the Restrictions Influence on Life Quality

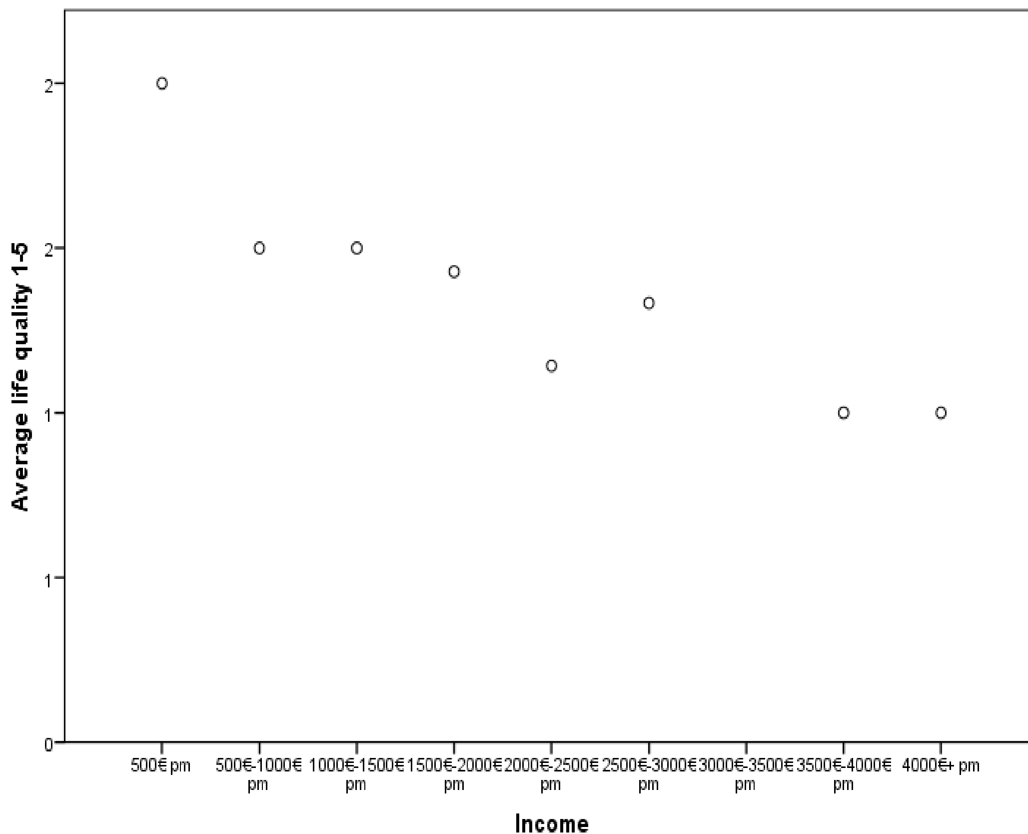
Initially, we wanted to investigate if there was a correlation between our patients' subjective feeling in restriction after the operation and monthly income, to ascertain if social status is influencing the self-estimated functional situation. Considering the statistics shown in the following figure, one can observe that the mean self-reported restriction is decreasing with the monthly income of our patients. When tested with Spearman's Test we found a weak trend to a negative correlation of -0.24 (p-value 0.125).

Fig. 19.: Income in relation to average restriction



Secondly, we analyzed how monthly income and the subjective life quality of the participants interact. Generally, a slight decrease in life quality due to the operational outcome in relation to the patients' monthly income is identifiable. The correlation has mainly been influenced by a discordant value in the group earning between 2500 and 3000€, resulting in a nonsignificant correlation coefficient of -0.113 (p-value 0.474).

Fig. 20.: Income in relation to average loss in life quality



3.4.6 Handedness and Operated Sides

The last question of our questionnaire was asking about the handedness of the patients. The results were 43 right handed persons (87.7%) and 6 left handed (12.3%). 33 of them have been operated on their dominant hand (67.3%) and 16 (32.7%) on their non-dominant side. When relating post-operative functional restriction to the dominant or non-dominant hand, we found that patients' operated on the dominant side answered the question averagely with 1.68 and those operated on the other side with 2.

Furthermore, patients who have been operated at the dominant hand reached a slightly better outcome regarding the influence of the functional results on their life quality than those operated on the non dominant. The average scores in loss of quality of life relative to the operated sides reached 1.45 in case of the patients being operated at the dominant side and 1.56 for the non-dominant.

Expectations to the operation also did not vary between the dominant and non dominant group. Both groups mostly answered the question about if the operation fulfilled their expectations with yes. Only one patient operated, at the non dominant side and two operated on the reverse side, felt that the operation did not reach the expected outcome.

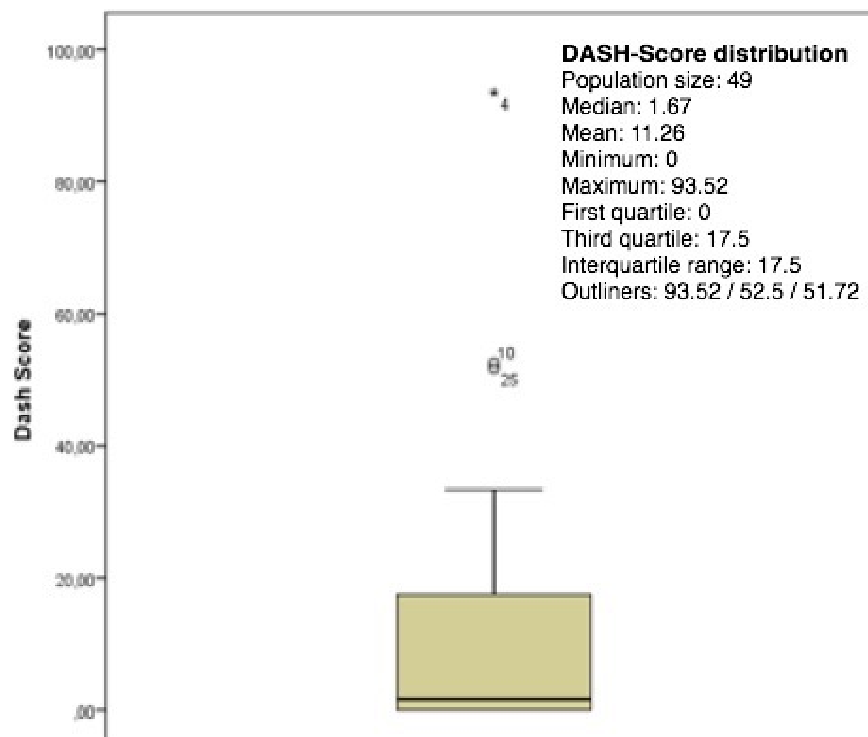
3.5 Evaluation of DASH

3.5.1 General Results of DASH

Disabilities of the Arm, Shoulder and Hand (DASH) is an outcome measure based on a 30 questions self report about general daily activities and eight additional questions referring to sport/music and work. It was designed to measure physical, as well as functional symptoms in patients who underwent surgery in the upper limb, or suffer from any disorders in this part of their body. We used it to achieve an overview of our patients' functional status and symptoms after surgery.

The questionnaire is essentially divided into two parts, the first part produces a synopsis of the patients' ability and the DASH-Score and the second part, an optional section, is dealing with sport / music and work.

Fig. 21.: DASH-Score distribution



The actual DASH score is calculated by summing up all points given in the first part, subtracting 1 and dividing the result by the number of answered questions (a minimum of 27 has to be answered to calculate the score), afterwards multiplied with 25. This value on a scale between 1 and 100 represents the grade in disability, with higher scores representing higher grades of disability.

All patients answered the minimal required amount of questions, enabling us to calculate a score for each of them. Generally, we got a distribution between 0 and 93.5 with an average value of 11.3 and a median of 1.67. The first quartile starts with 0 the third with 17.5 which lead to an interquartile range of 17.5. The three outliers refer to a case of a synovial sarcoma (93.5), a case of a giant cell tumor of the tendon sheath (52.5) and a chondroma case (51.7).

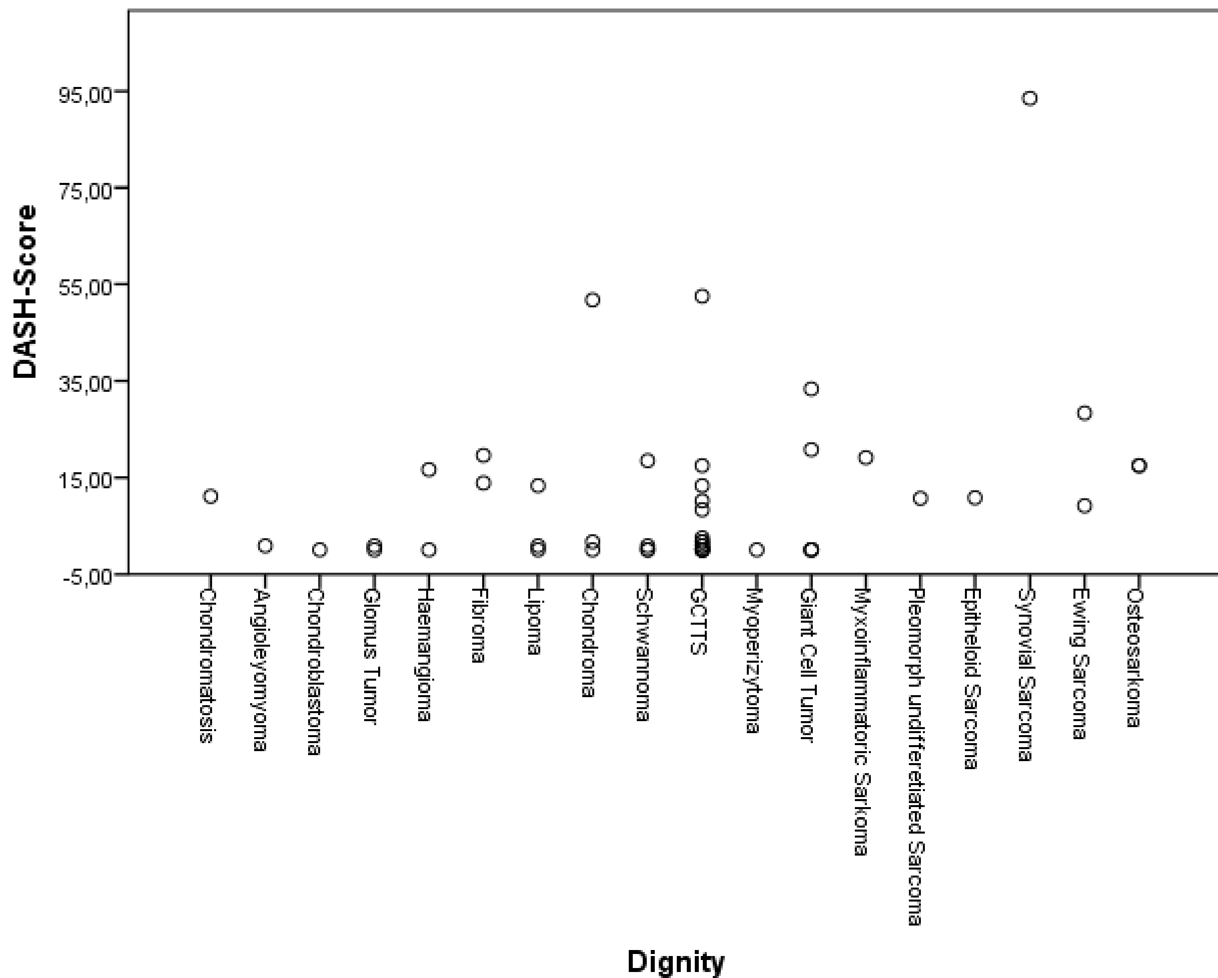
3.5.2 DASH-Score Relative to Diagnoses

Because of the great variety in different tumor dignities it was also important to evaluate the DASH-Scores according to the diagnosis. We assorted them into three basic groups of malignant, semi malignant and benign tumors and calculated average scores of 25.8 in the malignant group, 9 in the semi malignant and 7.6 in the benign group. In the catenation, we calculated a not insignificant correlation of 0.253 (Spearman´s rho/ p=0.083) which might have been raised by sorting them differently.

In case of the specific dignities, we calculated a median for each group of more than three patients. That led to an average score of 10.8 in case of giant cell tumors, 7.3 in case of GCTTS´s, 4.8 for schwannomas, 17.8 for chondromas and 4.7 for the cases with lipomas.

The entire depiction of all results is shown in figure 22 below.

Fig. 22.: DASH in relation to the diagnosis



3.5.3 DASH-Scores in Relation to the Tumors Location

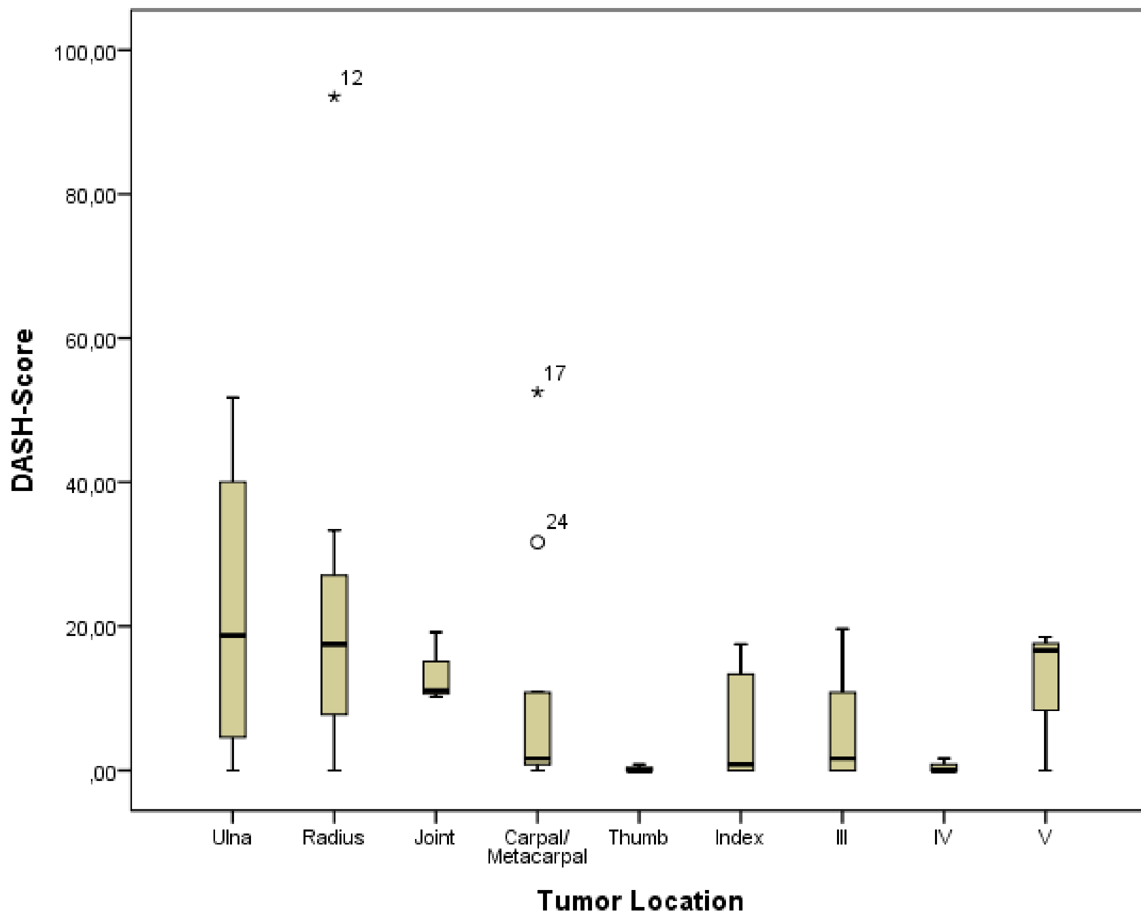
Patients who underwent surgery on their dominant hand/forearm, reached an average score of 10.5, those operated on the non-dominant side 12.9. The average DASH-Scores regarding the anatomical location of the tumors and the tumor count in the different locations are shown in the figure and the table below.

Two Ewing sarcomas confounded the score reached in the ulnar section. The outlier marked with 12* is a consequence of the solitary amputation in the whole survey, the therapeutic consequence of a synovial sarcoma of the distal radius. The two outliers in the carpal/metacarpal group are based on a sarcoma (24*) which had to be resected including extending tendons and a GCTTS in the palm (17*).

Table 3.: Tumor quantity in the different locations

Ulna	Radius	Wrist	Carpal/ Metacar pal	Thumb	Index	III	IV	V
4	8	3	9	4	5	8	6	3

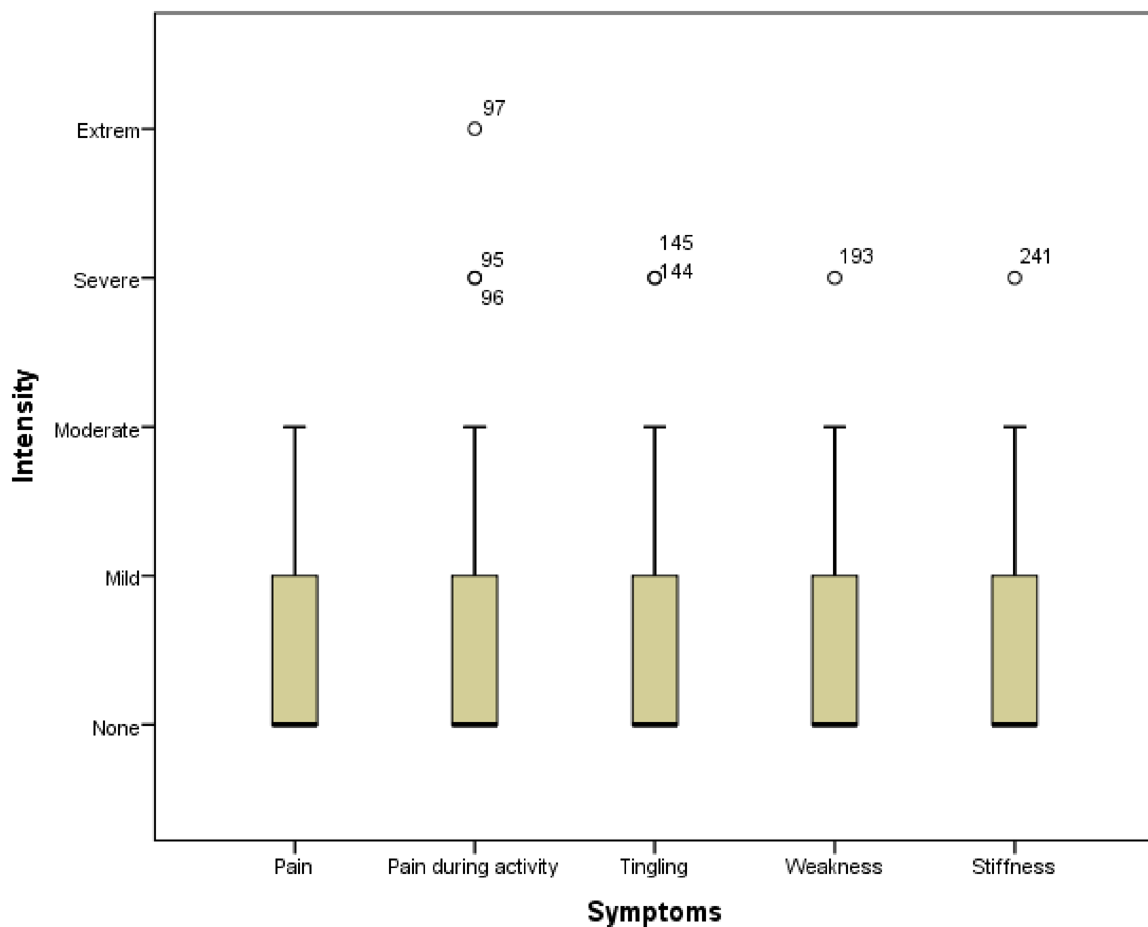
Fig. 23.: DASH in relation to the tumors' location



3.5.4 Postoperative symptoms

DASH also includes a section working with symptoms, based on five questions asking for pain, pain during activities, tingling, weakness and stiffness. According to this symptom section more than 60% of our patients did not have any postoperative symptoms in their arms or hands. Mild symptoms have been stated by 18-25% of the participants. More severe symptoms have only been declared by a small number. Only one person stated to suffer from extreme pain during activities.

Fig. 24.: Postoperative symptoms



3.5.5 Optional Part of DASH (work and sports/music module)

The final eight questions of the questionnaire cover the topics of work and hobbies (sports and/or music). This part is optional and could have been skipped by patients who are not working (in case of retirement or unemployment) or those who are not playing an instrument or do a sport.

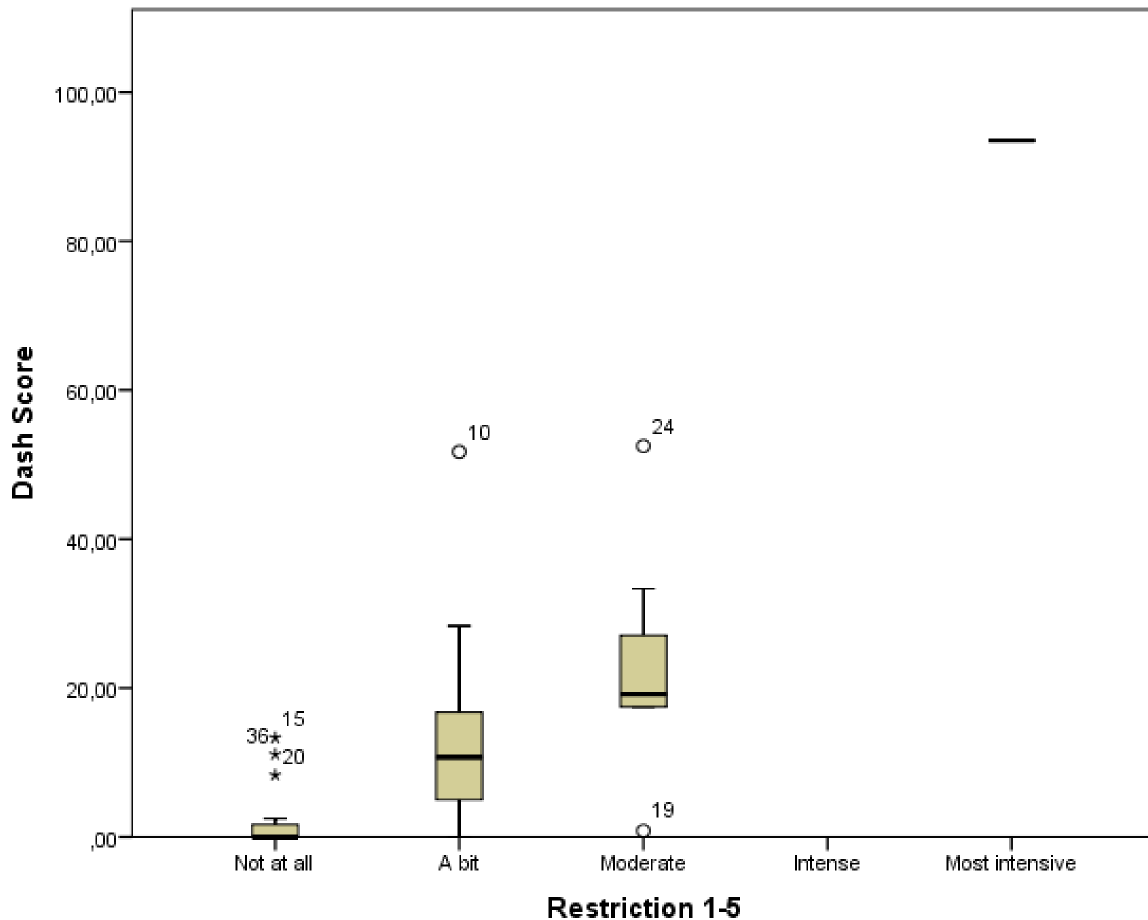
Since 19 (38.76%) of our participants were retired and one was unemployed, the optional has not been answered by the majority. The sport and music questions did not reach a high number of answers, as well. In total, 21 (42.84%) persons did not answer the question.

For those who answered the questions, we found an average score of 1.45 for all the questions where the average scores of the single answers ranged between 1.24 and 1.64.

3.5.6 DASH-Score Dependent on the Subjective Rating of Restriction

To evaluate our patients' self-rated subjective degree of restriction after the operation, the next figure shows DASH-Scores in relation to the patients' assessment on the first question of our questionnaire (How far have you been restricted in the function of your arms and/or hands due to the operation? 1= not at all and 5=most intensive). The ordinate represents the DASH-Scores by relation to the points given by the participants. According to the statistics we can say that an increasing DASH-Score correlates to an increasing degree in the subjective rating of restriction, which was proved with Spearman´s test reaching a correlation coefficient of 0.725 (p-value 0.01).

Fig. 25.: DASH-Score in relation to postoperative restriction

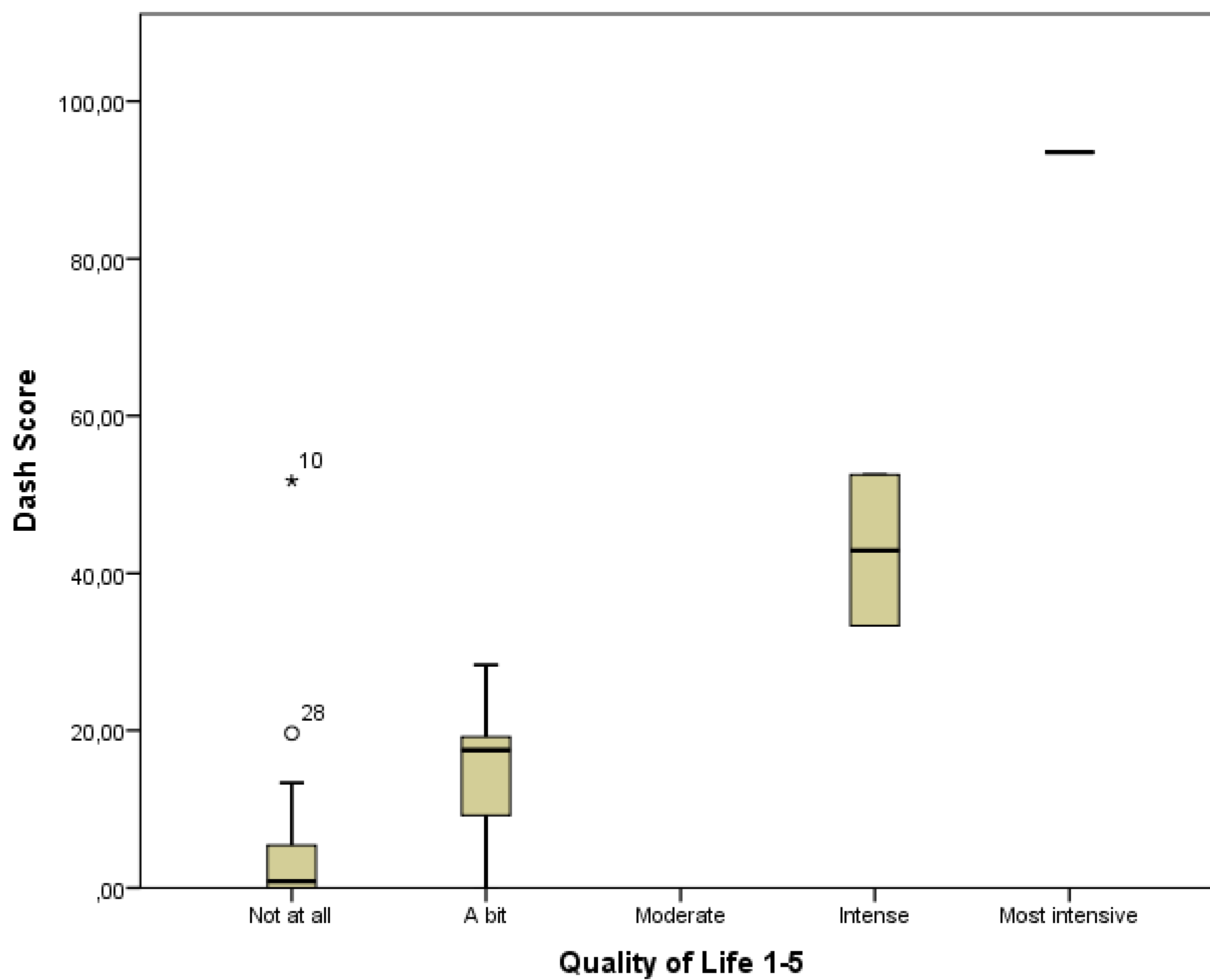


3.5.7 DASH-Scores in Relation to the Subjective Rating of the Individual Restriction's Influence on Life Quality

We also wanted to investigate if our patients' subjective assessment on the influence of the restriction on their life quality correlated with their DASH-Scores. The next figure shows the DASH-Scores relative to the patients' assessment on the second question of our questionnaire (To which extent does this restriction is making an impact on your daily life? "1= not at all" until "5=most intensive").

The relation between DASH-Scores and restriction´s influence on life quality behaves nearly similarly as the relation between DASH and restriction (Spearman's test: correlation coefficient of 0.58 p-value 0.01).

Fig. 26.: DASH-Score in Relation to Postoperative Life Quality



4. Discussion

4.1 Introduction and General Summary of the Results

The aim of this work was an evaluation of the postoperative status of patients who have been operated on their hand or forearm due to a tumor in the Department of Orthopaedic Surgery, University Hospital of Graz. For that purpose we evaluated our patients' condition with three different questionnaires, analyzing the clinical postoperative status as well as their level in life satisfaction, during a ten year period.

Considering general state of health and psychological issues, we mostly have found positive outcomes, with only ten percent of our participants have not been satisfied with their current health status. Concerning the functional status, which we analyzed with Disability of the Arm Shoulder and Hand (DASH) questionnaire, we calculated a mean score of 11.26 (out of 100). Our own questionnaire regarding postoperative restriction, quality of life and social attributes was mainly used to find correlations within the different topics but also depicted that more than 50% of our patients have been satisfied with the result of the operation.

4.2 Limitations

Our study has several limitations, caused to a variety of constraints we had to accept. The first decision we had to make, was choosing a prospective or retrospective study style. The choice includes a set up in time and finally determines whether it is possible to analyze a difference in pre- and post-operative function. Due to the small number of patients confronted with a tumor of the distal forearm or hand, we chose a retrospective study without the possibility to follow our patients' progress but instead opted for a larger sample size; Because of the temporal extent of the department's tumor database we chose a time period of 10 years, where the maximum number of patients matched our set terms in space and disease. Thus, however, this longitudinal frame was set at a level not feasible for a small prospective pilot study. With the decision for a retrospective study we had finally 124 patients included in our cohort.

The difficulty of the ten year time period did also influence our decision against clinical functional tests and examinations, because there could have been a non-assessable influence on detailed functions based on the maximum time of follow up of eleven years.

Regarding the choice of our questionnaires, we were leaking an analysis of postoperative appearance as RA Pearl et al. (50) have criticized in their paper about three dimensional assessments after hand surgical procedures, which in their opinion has to be based on functional, psychological and optical results.

Finally, the questionnaire we have designed autonomously, which is assessing patients' satisfaction, expectations and socioeconomic factors has not been validated yet, so we cannot measure or guarantee its reproducibility.

4.3 SF 12 as a Tool in Tumor Orthopedics

"Taking only two to three minutes to complete, the SF-12v2 is a practical, reliable and valid measure of physical and mental health and is particularly useful in large population health surveys or for applications that combine a generic and disease-specific health survey." states the introducing article of the promoting website. Our decision to use the SF 12 was based on its first argument, its shortness and wide distribution in different disciplines. Because our cohort has not been a large study population we wanted to keep the response level as high as possible and decided to limit the paperworks on SF 12 rather than SF 36. This decision has also been lead by the findings of C. Jenkinson et al. (51) who have compared SF 12 to SF 36 and found that both are producing the same results. We can conclude that the form and content of SF 12 was accepted by our patients because all returned questionnaires have been fully answered. The results considering general state of health, with only 8% and 2% of our patients estimated their health status as fair and poor, respectively, the fact that only 23% women and 9% men were rated below an average physical health state, are showing a largely positive postoperative outcome.

In the subject of mental health issues, both women (84%) and men (87%) were showing a high percentage in being at or above a general population's state of mental health. Additionally, the mental component scores achieved by our patients (women=52 / men=55 where values below 50 are considered as below the general population´s score) have even been better than the results of a German study assessing the SF questionnaire in a large

cohort (women=48.1 / men=50.5) (52). This aspect also underlines the positive and satisfying outcome of our tumor surgery but could also be interpreted as an influence of the high quality of life in Austria.
Considering, the basic depression screening of SF 12, it produced slightly doubtful data in the case of our male participants. According to epidemiological data (53) a prevalence of 0% for developing a depression in a normal population does not seem to be reliable but could also be related to the already mentioned high quality of life.
Since S. Gill et al. (54) and G. Vilagut et al. (55) came to the conclusion of the mental health component of SF 12 being a valid measurement in depression screening, our result might also be related to the small number of participants and an uncommonly well mental health status of the male participants.

4.4 DASH and Tumors

DASH is a frequently used and widespread tool in assessing the pre- and post-operative status of patients who have undergone surgery at the upper limb. To our knowledge it had not been used in a study concerning a wide variety of tumors by now.
The mean DASH score we received for the whole cohort was 11.26, with the different groups reaching 7.6 in case of benign lesions, 9 for semi malign and 25.8 malign dignities. Compared to the studies of Mirous et al. and Matsubara et al., who have been especially working on sarcoma cases of the hand and wrist, our malignant average score (which is also entirely based on sarcoma cases) is settled near their average DASH-Scores of 18 (56) and 21 (in case of wide resections and 3.9 in case of acridine orange therapy) (57). Other groups also working on sarcoma cases of the upper extremity found average DASH Scores of 30 (58), and 35 (59). Concerning amputations, we only had one case, with a score of 93.5 which matches the results of A. Leithner et al. who previously did a survey on amputated patients with malignant primary lesions of the upper limb, at our department, reaching a mean Dash Score of 92.4 (60).
Other groups like H. Fuji et al. have been using DASH in specific case studies (Dash Score 22.5 in a series of epitheloid sarcomas) (61) which makes them less comparable to our study, but their results are also matching ours.

Regarding the symptom section of DASH, 60% of our patients did not have any postoperative symptoms at all and according to the specific symptoms 18-25% had mild symptoms after the operation. In correlation with the results of SF 12, where 72% of the participants declared their current health status as very good up to excellent it can be said that both measures are supporting each others outcome.
Additionally it has to be mentioned that the DASH-Scores, which have to be seen as the most objective questionnaire in our study, did correlate with our patients' self estimated subjective rating of restriction and loss in quality of life (Spearman´s rho 0.725/p=0.01 and 0.58/p=0.05) which indicates a surprisingly good self-assessment of our patients. Furthermore, it shows that pure DASH scores might also be used as a measurement concerning patients' satisfaction.
Since the main target of DASH is the analysis of function and symptoms, and its final score represents the extent of a patient's disability on a scale between 0 and 100, our results have been largely gratifying and are indicating a satisfactory outcome of our patients.

4.5 Influence of the Operated Side on the Patients' Postoperative Satisfaction and Quality of Life

Our handedness is usually developed in early childhood and new theories about its choice are promoted occasionally. One of those is the "Energy availability hypothesis" which states that during the first nine weeks of life either the left or the right subclavian artery evolves faster and leads to the lateralisation of our handedness due to better nourishment of the respective side (62). Another observation about the development of human handedness are ultrasound images of fetuses already sucking the thumb of their future dominant hand (62).
Due to the concept of neuroplasticity most people will stay with this decision until the end of their lives and for that reason, human beings are not extremely likely to adapt to new circumstances. Especially with increasing age our bimanual capacities are fading because of a loss in microstructural organization of the brain (63).
Based on these facts, we assumed that small losses of manual function would cause great dissatisfaction and slow or even no adjustment.

Regarding handedness our cohort shows the normal distribution of nearly 90% (87.7%) right handed participants which matches the commonly mentioned amount in literature (64).
However, our explanation for these findings did not seem to prove right. 67% of our patients have been operated on their dominant hand and 33% on the non dominant, and both groups did only slightly differ in terms of functional restriction and loss in quality of life.
When we relate this fact to the main aim of this work the conclusion has to be made that tumor surgery does not interfere with people's lives and therefore does reach patients' expectations and satisfaction.
The last statement included another most interesting fact we found during our analysis. More than two-thirds of our participants have had a tumor on their dominant side, similarly to findings by Lautenbach et al. in their study about GCTTS' (16). However, Giant-cell tumors of the tendon sheath in our study population showed an even distribution for dominant and non-dominant side, therefore we assumed that our findings were not owed to this subset of tumor dignity. The fact could be based on patient's higher dissatisfaction in daily life and therefor earlier presentation in hospital, or other reasons which could vaguely be interpreted with more frequent tumor growth in more intensively used structures. However, the distribution can also be grounded on a bias due to non responses or a selection bias.

4.6 Socioeconomic Factors and Patients' Satisfaction

Socioeconomic factors are becoming a widely discussed part of modern medicine and medical education. Simultaneously, the influence of social status on patients' level of satisfaction and postoperative outcome developed to a topic of increasing interest.
To debate this subject, we have to consider our results about social parameters (represented by monthly income) depicted in figures 19. and 20. where we analyzed the correlation between restriction, life quality loss (due to postoperative restriction) and monthly earnings. Possibly owing to the small number of participants we did not find a statistically significant correlation between postoperative satisfaction and growing income (Spearman's

rho: restriction / income 0.24/p=0.125 and quality of life / income 0.113/p=0.474), however a trend is visible.
Another interesting circumstance is shown in the figure dealing with the expected outcome of the operation and family status (Graph 12.). One will immediately recognize that there are no dominant negative answers in any of the specific groups of family status. The only outbreak might be seen in the group of ”singles“ where we got two people having answered the question with ”No“, which seems to be relatively high (18% of the singles) compared to the other groups which only showed one more (2.6% of the other three groups) negative answer. However, these findings can be explained by both the negative answers have been made by sarcoma patients who underwent highly invasive tendon exchange operations and therefore their answers cannot be related to their family status.
In conclusion, we came to the same result as Robert L. et al. (65) and R. Allen Butler et al. (66) who studied the outcome of total knee and hip arthroplasties, respectively, concerning socioeconomic factors and also found a decrease in satisfaction with lower income.
Although, both studies mentioned have been working with different diseases than we did, our results have to be noted as an expansion in the context of outcome measures in orthopaedic procedures. In addition, this conclusion is supported by the fact that we had a similar distribution in age (both average of 54 years) and gender (61% and in case of our study 55% women) as Robert L. et al. (65).

4.7 Influence of Drop-Outs

The question which instantly arises is the one about patients who did not return the questionnaires and for that reason could not be included into our evaluation and might have influenced the whole survey.
The first argument which is disproving this theory are the percental rates of the tumor dignities before and after the return of our questionnaires. The distribution did only change slightly which can be observed in Table 2. (Tumor dignities and count at each location). Especially the biggest groups of GCTTS’s and Giant cell tumors have only changed minimally. Concerning the other dignities, the group of Lipomas underwent the highest percental loss from 11.4% to 6.1%. Since there are no specific studies about epidemiology of hand and forearm tumors we did not have a measurement to confer our cohort with.

Concerning the returned questionnaires the slightly higher percentage of 16% malign lesions compared to 12% in the initial cohort might be explained by peoples personal opinion of importance. While having had a therapy for small benign lesions has probably faded into obscurity, a malign disease will always be remembered for a lifetime.
Other break offs are based on deceased patients. Especially the outcome of the two patients who have been operated due to metastases would have been of extraordinary interest but they died after our operation as a consequence of the primary disease.

4.8 Future Possibilities

Since there are not many groups that researched epidemiological data concerning tumors of the hands and forearms yet, our work can be considered as a supporting step in this direction. To make it a more reliable source it should be enlarged to a multi-centric concept with other university hospitals.
Another point of interest would be the future evaluation of pre- and postoperative DASH scores or other patient related tools to achieve better comparability and the possibility of studying the patients progression through treatment. Therefore, one could start to include DASH (or other questionnaires like MSTS) into every preoperative examination. Furthermore, it would be of enormous help for every future retrospective orthopaedic study to record the range of motion of every patient’s operated joint (or the surrounding joints of an operation) in a standardized digital way. This would not only affect the efficiency of clinical studies but also the daily clinical routine.
Despite for growing academical knowledge and the influence on clinicians’ work, the topic has also to be considered as a support on society and economy. Since most people are spending their lives with manual labour, all diseases of the hand and directly connected structures like the forearm, have to be recognized as strong impacts on a personal level and on general workforce. In this context, many studies have already shown that the soonest possible come-back after a disease leads to the most efficient reintegration at the workplace, as well as the best outcome for the patient in general. In case of tumors this goal can only be achieved with a proper and early treatment which in turn is always based on efficient and extensive analysis of the results.

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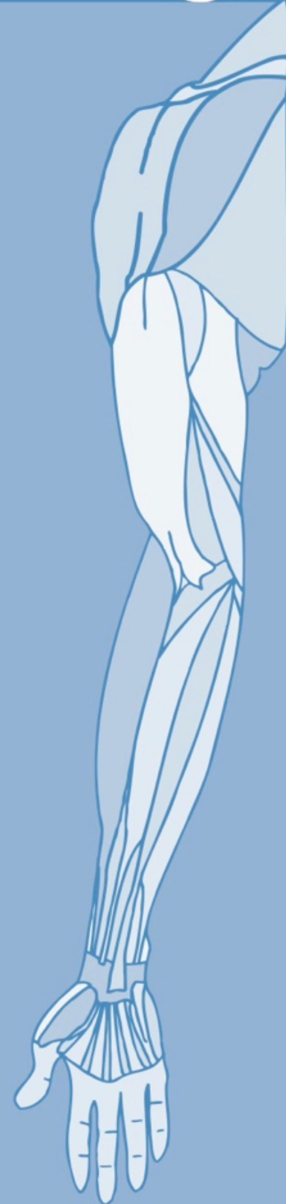
6. Questionnaires

DISABILITIES OF THE ARM, SHOULDER AND HAND

DER

DASH-Fragebogen



ANLEITUNG

Dieser Fragebogen beschäftigt sich sowohl mit Ihren Beschwerden als auch mit Ihren Fähigkeiten, bestimmte Tätigkeiten auszuführen.

Bitte beantworten Sie *alle Fragen* gemäß Ihrem Zustand in der vergangenen Woche, indem Sie einfach die entsprechende Zahl ankreuzen.

Wenn Sie in der vergangenen Woche keine Gelegenheit gehabt haben, eine der unten aufgeführten Tätigkeiten durchzuführen, so wählen Sie die Antwort aus, die Ihrer Meinung nach *am ehesten* zutreffen würde.

Es ist nicht entscheidend, mit welchem Arm oder welcher Hand Sie diese Tätigkeiten ausüben. Antworten Sie Ihrer Fähigkeit entsprechend, ungeachtet, wie Sie die Aufgaben durchführen konnten.

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Deutsche Version:
Günter Germann, Angela Harth, Gerhard Wind, Erhan Demir.
University of Heidelberg.

Disabilities of the Arm, Shoulder and Hand

Bitte schätzen Sie Ihre Fähigkeit ein, wie Sie folgende Tätigkeiten in der vergangenen Woche durchgeführt haben, indem Sie die entsprechende Zahl ankreuzen.

	Keine Schwierigkeiten	Geringe Schwierigkeiten	Mäßige Schwierigkeiten	Erhebliche Schwierigkeiten	Nicht möglich
1. Ein neues oder festverschlossenes Glas öffnen	1	2	3	4	5
2. Schreiben	1	2	3	4	5
3. Einen Schlüssel umdrehen	1	2	3	4	5
4. Eine Mahlzeit zubereiten	1	2	3	4	5
5. Eine schwere Tür aufstoßen	1	2	3	4	5
6. Einen Gegenstand über Kopfhöhe auf ein Regal stellen	1	2	3	4	5
7. Schwere Hausarbeit (z. B Wände abwaschen, Boden putzen)	1	2	3	4	5
8. Garten- oder Hofarbeit	1	2	3	4	5
9. Betten machen	1	2	3	4	5
10. Eine Einkaufstasche oder einen Aktenkoffer tragen	1	2	3	4	5
11. Einen schweren Gegenstand tragen (über 5kg)	1	2	3	4	5
12. Eine Glühbirne über Ihrem Kopf auswechseln	1	2	3	4	5
13. Ihre Haare waschen oder fönen	1	2	3	4	5
14. Ihren Rücken waschen	1	2	3	4	5
15. Einen Pullover anziehen	1	2	3	4	5
16. Ein Messer benutzen, um Lebensmittel zu schneiden	1	2	3	4	5
17. Freizeitaktivitäten, die wenig körperliche Anstrengung verlangen (z. B. Karten spielen, Stricken, usw.)	1	2	3	4	5
18. Freizeitaktivitäten, bei denen auf Ihren Arm, Schulter oder Hand Druck oder Stoß ausgeübt wird (z.B. Golf, Hämmern, Tennis, usw.)	1	2	3	4	5
19. Freizeitaktivitäten, bei denen Sie Ihren Arm frei bewegen (z. B. Badminton, Frisbee)	1	2	3	4	5
20. Mit Fortbewegungsmitteln zurecht zukommen (um von einem Platz zum anderen zu gelangen)	1	2	3	4	5
21. Sexuelle Aktivität	1	2	3	4	5

22. In welchem Ausmaß haben Ihre Schulter-, Arm- oder Handprobleme Ihre normalen sozialen Aktivitäten mit Familie, Freunden, Nachbarn oder anderen Gruppen während der vergangenen Woche beeinträchtigt? *(Bitte kreuzen Sie die entsprechende Zahl an)*

Überhaupt nicht	Ein wenig	Mäßig	Ziemlich	Sehr
1	2	3	4	5

23. Waren Sie in der vergangenen Woche durch Ihre Schulter-, Arm- oder Handprobleme in Ihrer Arbeit oder anderen alltäglichen Aktivitäten eingeschränkt? *(Bitte kreuzen Sie die entsprechende Zahl an)*

Überhaupt nicht eingeschränkt	Ein wenig eingeschränkt	Mäßig eingeschränkt	Sehr eingeschränkt	Nicht möglich
1	2	3	4	5

Bitte schätzen Sie die Schwere der folgenden Symptome während der letzten Woche ein. *(Bitte kreuzen Sie in jeder Zeile die entsprechende Zahl an)*

	Keine	Leichte	Mäßige	Starke	Sehr starke
24. Schmerzen in Schulter, Arm oder Hand	1	2	3	4	5
25. Schmerzen in Schulter, Arm oder Hand während der Ausführung einer bestimmten Tätigkeit	1	2	3	4	5
26. Kribbeln (Nadelstiche) in Schulter, Arm oder Hand	1	2	3	4	5
27. Schwächegefühl in Schulter, Arm oder Hand	1	2	3	4	5
28. Steifheit in Schulter, Arm oder Hand	1	2	3	4	5

29. Wie groß waren Ihre Schlafstörungen in der letzten Woche aufgrund von Schmerzen im Schulter-, Arm- oder Handbereich? *(Bitte kreuzen Sie die entsprechende Zahl an)*

Keine Schwierig-keiten	Geringe Schwierig-keiten	Mäßige Schwierig-keiten	Erhebliche Schwierig-keiten	Nicht möglich
1	2	3	4	5

30. Aufgrund meiner Probleme im Schulter-, Arm- oder Handbereich empfinde ich meine Fähigkeiten als eingeschränkt, ich habe weniger Selbstvertrauen oder ich fühle, dass ich mich weniger nützlich machen kann. *(Bitte kreuzen Sie die entsprechende Zahl an)*

Stimme überhaupt nicht zu	Stimme nicht zu	Weder Zustimmung noch Ablehnung	Stimme zu	Stimme sehr zu
1	2	3	4	5

DASH Wert für Behinderung/Symptome = $\left[\frac{\text{(Summe der n Antwortpunkte)}}{n} - 1\right] \times 25$,

wobei n der Anzahl der beantworteten Fragen entspricht

Wurden mehr als 3 Fragen nicht beantwortet, so darf ein DASH Wert nicht berechnet werden.

SPORT- UND MUSIK-MODUL (OPTIONAL)

Die folgenden Fragen beziehen sich auf den Einfluss Ihr es Schulter-, Arm- oder Handpr oblems auf das Spielen Ihr es Musikinstrumentes oder auf das Ausüben Ihres Sports oder auf beides.
Wenn Sie mehr als ein Instrument spielen oder mehr als eine Sportar t ausüben (oder beides), so beantworten Sie bitte die Fragen in bezug auf das Instrument oder die Sportart, die für Sie am wichtigsten ist.
Bitte geben Sie dieses Instrument bzw. diese Sportart hier an:

☐ Ich treibe keinen Sport oder spiele kein Instrument (Sie können diesen Ber eich auslassen).

Bitte kreuzen Sie die Zahl an, die Ihre körperlichen Fähigkeiten in der vergangenen Woche am besten beschreibt.
Hatten Sie irgendwelche Schwierigkeiten:

	Keine Schwierig-keiten	Geringe Schwierig-keiten	Mäßige Schwierig-keiten	Erhebliche Schwierig-keiten	Nicht möglich
1. In der üblichen Art und Weise Ihr Musikinstrument zu spielen oder Sport zu treiben?	1	2	3	4	5
2. Aufgrund der Schmerzen in Schulter, Arm oder Hand Ihr Musikinstrument zu spielen oder Sport zu treiben?	1	2	3	4	5
3. So gut Ihr Musikinstrument zu spielen oder Sport zu treiben wie Sie es möchten?	1	2	3	4	5
4. Die bisher gewohnte Zeit mit dem Spielen Ihres Musikinstru-mentes oder mit Sporttreiben zu verbringen?	1	2	3	4	5

ARBEITS- UND BERUFS-MODUL (OPTIONAL)

Die folgenden Fragen beziehen sich auf den Einfluss Ihr es Schulter-, Arm- oder Handproblems auf Ihre Arbeit (einschließlich Haushaltsführung, falls dies Ihre Hauptbeschäftigung ist).
Bitte geben Sie Ihre/n Arbeit/Beruf hier an:

☐ Ich bin nicht berufstätig (Sie können diesen Ber eich auslassen).

Bitte kreuzen Sie die Zahl an, die Ihre körperlichen Fähigkeiten in der vergangenen Woche am besten beschreibt.
Hatten Sie irgendwelche Schwierigkeiten:

	Keine Schwierig-keiten	Geringe Schwierig-keiten	Mäßige Schwierig-keiten	Erhebliche Schwierig-keiten	Nicht möglich
1. In der üblichen Art und Weise zu arbeiten?	1	2	3	4	5
2. Aufgrund der Schmerzen in Schulter, Arm oder Hand Ihre übliche Arbeit zu erledigen?	1	2	3	4	5
3. So gut zu arbeiten wie Sie es möchten?	1	2	3	4	5
4. Die bisher gewohnte Zeit mit Ihrer Arbeit zu verbringen?	1	2	3	4	5

Auswertung der optionalen Module: Die Antwortpunkte der Fragen werden summiert; durch 4 (Anzahl der Fragen) dividiert; 1 wird subtrahiert und danach mit 25 multipliziert.
Für die Auswertung eines optionalen Moduls dürfen keine Antworten fehlen.

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Ihre Gesundheit und Ihr Wohlbefinden

In diesem Fragebogen geht es um die Beurteilung Ihres Gesundheitszustandes. Der Bogen ermöglicht es, im Zeitverlauf nachzuvollziehen, wie Sie sich fühlen und wie Sie im Alltag zurechtkommen. *Vielen Dank für die Beantwortung dieses Fragebogens!*

Bitte kreuzen Sie für jede der folgenden Fragen das Kästchen ☒ der Antwortmöglichkeit an, die am besten auf Sie zutrifft.

1. **Wie würden Sie Ihren Gesundheitszustand im Allgemeinen beschreiben?**

Ausgezeichnet	Sehr gut	Gut	Weniger gut	Schlecht
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2. **Die folgenden Fragen beschreiben Tätigkeiten, die Sie vielleicht an einem normalen Tag ausüben. Sind Sie durch Ihren derzeitigen Gesundheitszustand bei diesen Tätigkeiten eingeschränkt? Wenn ja, wie stark?**

	Ja, stark eingeschränkt	Ja, etwas eingeschränkt	Nein, überhaupt nicht eingeschränkt
a Mittelschwere Tätigkeiten, z.B. einen Tisch verschieben, staubsaugen, kegeln, Golf spielen	☐ 1	☐ 2	☐ 3
b Mehrere Treppenabsätze steigen	☐ 1	☐ 2	☐ 3

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3. Wie oft hatten Sie in den vergangenen 4 Wochen aufgrund Ihrer körperlichen Gesundheit irgendwelche Schwierigkeiten bei der Arbeit oder anderen alltäglichen Tätigkeiten im Beruf bzw. zu Hause?

	Immer	Meistens	Manchmal	Selten	Nie
a Ich habe weniger geschafft, als ich wollte	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
b Ich konnte nur bestimmte Dinge tun	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

4. Wie oft hatten Sie in den vergangenen 4 Wochen aufgrund seelischer Probleme irgendwelche Schwierigkeiten bei der Arbeit oder anderen alltäglichen Tätigkeiten im Beruf bzw. zu Hause (z.B. weil Sie sich niedergeschlagen oder ängstlich fühlten)?

	Immer	Meistens	Manchmal	Selten	Nie
a Ich habe weniger geschafft, als ich wollte	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
b Ich konnte nicht so sorgfältig wie üblich arbeiten	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

5. Inwieweit haben die Schmerzen Sie in den vergangenen 4 Wochen bei der Ausübung Ihrer Alltagstätigkeiten zu Hause und im Beruf behindert?

Überhaupt nicht	Etwas	Mäßig	Ziemlich	Sehr
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

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6. **In diesen Fragen geht es darum, wie Sie sich fühlen und wie es Ihnen <u>in den vergangenen 4 Wochen</u> gegangen ist. (Bitte kreuzen Sie in jeder Zeile die Zahl an, die Ihrem Befinden am ehesten entspricht). Wie oft waren Sie in den <u>vergangenen 4 Wochen</u>…**

		Immer	Meistens	Manchmal	Selten	Nie
a	ruhig und gelassen ?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
b	voller Energie ?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
c	entmutigt und traurig ?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

7. **Wie häufig haben Ihre <u>körperliche Gesundheit oder seelischen Probleme</u> in den <u>vergangenen 4 Wochen</u> Ihre Kontakte zu anderen Menschen (Besuche bei Freunden, Verwandten usw.) beeinträchtigt?**

Immer	Meistens	Manchmal	Selten	Nie
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Vielen Dank für die Beantwortung dieser Fragen!

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Die folgenden zwei Fragen beschäftigen sich mit dem Funktionsverlust welchen Sie eventuell nach der Operation erlitten haben. Bitte beziehen Sie sich mit ihrer Antwort auf die jetzige Situation.	gar nicht	leicht	mäßig	stark	sehr stark
1. Wie weit wurden sie durch die Operation in der Funktion Ihrer Hand/ Ihres Armes eingeschränkt?	1	2	3	4	5
2. Wie sehr wirkt sich dieser Funktionsverlust auf Ihre Lebensqualität aus?	1	2	3	4	5

	Ja	Ich weiß nicht	Nein
3. Entspricht ihr Zustand nach der Operation dem von Ihnen vor der Operation erwarteten?			

Die nun folgenden Fragen beschäftigen sich mit ihrer derzeitigen sozialen Situation:

4. Welchen Beruf üben sie aus? ____

	ledig	verheiratet	geschieden	verwitwet
5. Bitte nennen Ihren Familienstand.				

	bis 500€	500-1000€	1000-1500€	1500-2000€	2000-2500€	2500-3000€	3000-3500€	3500-4000€	4000 € +
6. Wie hoch war ihr Einkommen (Nettoverdienst) im letzten Monat?									

	Linkshänder	Rechtshänder
7. Bitte nennen sie Ihre dominante Hand.		

Bitte füllen sie noch die nächsten beiden Felder aus um uns die Zuordnung zu erleichtern.

Name, Vorname:____

Geburtsdatum:____

Vielen dank für Ihre Hilfe!