Title

An investigation to establish the flexor tendon rehabilitation protocol use amongst Occupational Therapists in South Africa.

A mini dissertation submitted for partial fulfilment of the Masters Degree in Hand Rehabilitation.

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Declaration

I, Nicola Jane Jamieson Venter, hereby declare that the work on which this mini dissertation is based is my own original work (except where acknowledgements and references indicate otherwise) and that neither the whole work nor any part of it has been, is being or will be submitted for another degree at this or any other university.

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1 November 2012

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Abstract

The aim of this study was to investigate which protocols Occupational Therapists (OT's) use when rehabilitating clients after flexor tendon repairs, and to investigate the therapist's knowledge regarding these protocols, to guide therapists and institutions in using effective methods within the South African context.

A questionnaire was sent to OT's in South Africa. Of the 32 responses, 50% had more than 10 years experience and 50%, less experience. 81.2% were private practitioners and 28% worked in government.

The trend of protocol use was as follows: 18.8% used a Duran-type passive mobilization protocol, 25% used a Kleinert-type protocol - a passive flexion protocol (but labelled an active mobilization protocol in literature as it allows active extension of the fingers), 28.1% used Early Active Mobilization and 3.1% used an Immobilization-type protocol. 64.5% of the sample used static splints, 9.7% used dynamic splints and 25.8% used a combination. Most (83.3%) continued the splint at 4 weeks but only 26.6% were using the splint at 6 weeks. At week 1, 30% allowed active flexion of the fingers, whereas at week 4 and 5, 60% allowed active flexion.

The referring doctor and confidence in one's own skills were the main factors influencing protocol choice. Resources available influenced the protocol choice, which can be problematic in South Africa. Access to literature was mostly through textbooks (90.6%), although journal articles were accessed (internet - 50%, hard copy - 62.5%). More than half of the sample attended courses regularly.

Most therapists were happy with their outcomes, regardless of which protocol used. Therapists need to build their confidence, realising the efficacy of various protocols is similar, according to research. Thus whatever factors influence protocol choice, they will likely not be critical to good outcomes.

Chapter 1
Introduction

1. 1. Background and rationale for the study

The purpose of this study was to investigate the knowledge and views of Occupational Therapists (OT's) in South Africa regarding the use of flexor tendon rehabilitation protocols to establish if there were preferences towards specific protocols. The literature review highlighted many opinions and scientific findings regarding best practice. The results of this study drew attention to the OT's choice of practice in the South African context and how it compared to the findings of the literature review.

Research within the South African context has been limited and published mainly by surgeons who have not necessarily been involved with the weekly therapy. Joubert (2005: 10), suggested that "*South African Occupational Therapists are particularly bad at producing research*", and Watson and Buchanan (2005) said that although relevant evidence was available, it tended to be dispersed amongst different sources such as social science, medical and educational databases and journals. They likewise said that South African OT's tended to lack confidence, had areas lacking in knowledge, and were unsure about evidence based practice (EBP) applicability within the South African context. Knowledge of current hand rehabilitation trends amongst hand therapists in South Africa would benefit the body of knowledge for surgeons and therapists alike. This knowledge would highlight the areas requiring improvement in the profession within the context of flexor tendon rehabilitation. Garner et al (2004), in their article on putting evidence into practice stated that the infrastructure in South Africa was conducive to change but required social interaction to mobilise the change.

Hands have been considered essential for every day function and workability. Without fully mobile and coordinated fingers, one would struggle with many aspects of daily living. Lacerations to the palmar aspect of the hand and fingers have often resulted in flexor tendon injuries (classified according to various Zones in the hand, with Zone I being most distal and Zone V being most proximal). These injuries have required surgical repair and a strict adherence to a rehabilitation protocol. A large proportion of South African employees worked in general labour situations or within an industrial context, and in some contexts, were the sole breadwinner. The importance of such employees having good hand function for earning a

living cannot be underestimated. Due to the nature of South Africa's rural / urban distribution, many hospitals were far from the rural communities and have been known to lack resources. For example, while clinicians in South Africa may have been able to access internet and library resources fairly easily in the urban settings, these facilities have been insufficient, non-existent or hard to access in many rural parts of South Africa (Joubert, 2005). Some of these hospitals have not been able to offer specialized services, such as hand surgeons and experienced hand therapists, as sufficient funding for essential staff cover has been a priority. The large number of patients and the difficult cases seen in the rural areas, complicated by insufficient resources or funds, resulted in OT's in South Africa not being able to find the time or the resources to obtain the necessary evidence to support their therapeutic approaches (Joubert, 2005). Contexts did not always allow for "first world" rehabilitation, including regular and frequent contact, and high quality materials. Watson and Buchanan (2005) reported on a national survey done in South Africa that showed some reasons why OT's did not put evidence into practice, namely a heavy service burden, lack of support from management and insufficient resources, which have not been isolated South African problems, but common the world over.

Yet South Africa has had good surgeons and therapists over the years, comparative to international standards, and in urban settings, it has been possible to provide regular high quality rehabilitation. This high quality rehabilitation often occurred in the private sector where sophisticated technology, comparative with the Western world's facilities, was available. Whereas often in the public sector (largely in the District Health centres), clinicians have struggled to keep up with patient load, which was largely the disadvantaged African people, and the clinicians have had to manage with unsophisticated equipment and much "red tape" to obtain new equipment or repairs (Joubert, 2005).

The research question originated from an enquiry by the researcher regarding what flexor tendon rehabilitation regimes OT's in South Africa were actually using and why? This enquiry was due to an interest in investigating trends, preferences and current protocols used in clinical practice, in order to advise therapists of these trends in South Africa, in relation to global contexts, so the profession could be more relevant and current. The literature review was intended to reveal some global trends, preferences and the efficacy of protocols used in rehabilitation of flexor tendon injuries. The results were expected to have assisted in guiding

junior or inexperienced therapists in protocol choice, and assisting experienced therapists in adapting their treatment methods accordingly.

Rehabilitation regimes after surgical repair in clients with flexor tendon injuries has been varied, and a frequently discussed topic amongst OT's and surgeons alike. The sheer volume of literature surrounding this topic has been a clear indication of this (Amadio, 2005, Braga-Silva and Kuyven, 2005, Cao et al, 2002, Cetin et al, 2001, Chambon, et al, 2001, Chan and Fung, 2006, Galanakis et al, 2003, Elliot. et al, 2005, Fenwick et al, 2002, Hung et al, 2005, Libberecht, et al, 2006, Lister et al, 1977, May et al, 1992, Riaz, et al, 1999, Saini, et al, 2010, Sántha et al, 1998, Savage et al, 2005, Stanley and Tribuzi, 1992, Stewart, 1991, Tanaka et al, 2005, Tang, 2007, Tiller et al, 2008, Vucekovich et al, 2005).

Chesney et al (2011) said that there was no agreement about which surgical method was the best, in flexor tendon repairs. This likewise suggested that no single therapeutic regime was the gold standard of treatment in these injuries (Pettengill, 2005, as cited in Tang, 2007). Some therapists have felt strongly about the efficacy of one protocol whilst others found that a particular protocol was not suitable in their setting, be it due to logistics (patient's inability to attend therapy sessions regularly or lack of patient transport or other issues) or insufficient infrastructure and support. Other therapists in clinical practice have been uncertain about the specifics of each protocol, or overwhelmed by the amount of information (regarding how, when and why to mobilise or splint clients) (Stewart, 1991, Vucekovich et al, 2005). Others have felt limited by their skill level, and have thus been reluctant to use certain regimens. Whilst others, have been specifically instructed by their referring doctor or guided by existing prescribed departmental protocols.

1.2. Defining and describing Flexor Tendon Protocols

A protocol for flexor tendon rehabilitation has been a defined method of treatment laid out according to wound and tendon healing time periods, stating which movements and the degree thereof, were allowed in each week of the treatment programme.

Wound healing has been known to progress in three basic phases, as described by Stanley and Tribuzi (1992):

- Phase 1 of inflammation, which would last about 3 to 5 days,

- Phase 2 of fibroplasia, which, depending on the extent of the wound, would last for about two to six weeks, and
- Phase 3 of scar maturation, which could continue for years.

Tendon healing has been found to follow a similar pattern. The type of collagen found in tendons (type I or adult collagen) has been found to form after 48 hours and has been predominant in the wound after day 3. During the inflammation phase, the tendon would become more vascular. During the fibroplasia phase, the tensile strength would increase over 3 weeks, which would mirror the increase in collagen content. At 3 weeks, collagen synthesis would equal collagen degradation and the tensile strength would become 15% that of normal. This would increase over 3 months, linearly. The scar maturation phase of tendon healing would be accelerated 3-4 times faster than normal (Stanley and Tribuzi, 1992). Elliot et al (2005) and Fenwick et al (2002) discussed how tendon healing occurred by both extrinsic and intrinsic mechanisms. Blood supply and a degree of adhesion formation post surgery, established extrinsic support for the healing tendon. Intrinsic healing was stimulated by means of ultrasound, laser light, radio frequency and the like (Elliot et al, 2005). Fenwick et al (2002) identified vascular infiltration of the tendon where the suture had penetrated the tendon, as well as at the tendon stump.

In the past, flexor tendon rehabilitation protocols have been divided into the first six weeks, where strict precautions and specific movements were required, and the latter six weeks where increasing amounts of free movement and resistance exercises were allowed. During the scar maturation phase, stress on the tendon influences scar remodelling, which has been helpful for rehabilitation, but too much stress (for example by means of active flexion) during the fibroplasia phase was often avoided by rehabilitation regimes. Surgical techniques have improved, allowing immediate active motion (Stanley and Tribuzi, 1992, Tang, 2007, Elliot et al, 2005). For example, Cao et al (2002) advocated using more sutures on the dorsal aspect of the tendon – the part subject to greater tension. Elliot et al (2005) recognised the benefit of circumferential sutures as well as core sutures, of which various methods have been implemented and adapted upon. The hand was kept in a splint or cast to protect it during these phases. (The word "splint" would refer to any apparatus used to position the injured hand, and may be made of various materials - thermoplastic, plaster-of-paris, backslab or other.)

There have been many variables within this structure of treatment, namely the various protocols, for example Duran, modified Duran, Kleinert, modified Kleinert (known by some as the Washington method), Strickland or Cannon, Immobilisation and others. The Duran and the Kleinert have been most referenced and some therapists may have regarded them as the "gold standard", although no consensus has yet been reached. Outlines of these two protocols have been provided in the literature review.

Stanley and Tribuzi (1992), in a chapter authored by Karen M. Stewart, described the Duran and Houser method as using a rubber band traction method similar to that of the Kleinert, but active extension was not allowed, only passive extension. Hunter et al (2002), had a chapter authored by Karen M. Stewart Pettengill and Gwendolyn van Strein, stating a similar protocol. Both these textbooks said the Duran protocol allowed the splint to be removed at 4.5 weeks and applied the tenodesis cuff or wrist band, with active flexion only being allowed at 5.5 weeks, when the tenodesis cuff was removed. Their view of the Kleinert protocol was that active flexion was initiated at week 4-6.

There appeared to be insufficient information about what and how much therapists knew about the protocols, even textbooks and articles differed on the specifics of the protocols. What did therapists think about the efficacy of the protocols and did they think these were effective in the clinical setting in South Africa? Stegink Jansen (2002), in her article relating to evidence-based practice specified that there was a difference between efficacy and effectiveness, as ideal circumstances for treatment were not always possible. This could sometimes be the case in the varying situations in South Africa. Joubert (2005) emphasized how important it was, as OT's, to keep abreast with updated global and local research, and apply the reasearch to the therapeutic context. But before the evidence has been integrated into clinical practice, OT's would need to be convinced the change outweighs the expense, the time and effort required as well as additional equipment that may have been needed (Watson and Buchanan, 2005). South Africa has been a prime example of varied circumstances in which these rehabilitation regimes have been applied. Therapists who have treated patients in settings with limited resources sometimes have had to settle for alternative protocols with which they may not be familiar, due to lack of materials or resources. An example of this would be using a Duran technique instead of a Kleinert technique as the Kleinert required pulleys.

Research had much to say regarding flexor tendon rehabilitation and in many instances, research showed contradictory findings regarding the efficacy of various rehabilitation protocols. Shear and Bear-Lehman (1989) questioned whether immobilisation was of greater value in Zone II flexor tendon repairs than mobilisation in their article comparing the two techniques - a long debated topic. Tang (2007) highlighted that immobilisation regimes have become antiquated amongst professionals in the speciality, yet generalists have still been making use of these regimes. Ewing Fess and McCollum (1998) emphasized the danger of immobilising structures for prolonged periods, as did Cyr and Ross (1998).

Further studies suggested that the immobilisation regime could be favourably replaced by early mobilisation regimes, the Kleinert regime of passive flexion and active extension of the fingers became favoured by many authors (Baktir et al, 1996, Chan and Fung, 2006, Chow et al, 1988, Earley and Milward, 1982, Edinburg et al, 1987, Elliot et al, 2005, Young and Harmon, 1959). More recently, early active flexion after flexor tendon repairs had been found to produce good or excellent results in some studies (Braga-Silva and Kuyven, 2005, Hung et al, 2005), as early as from day five post flexor tendon repair (Gérard et al, 1998) and even day three post repair (Hung et al, 2005). This active flexion regime has been becoming the favoured method of rehabilitation amongst certain authors (Baktir et al, 1996, Elliot et al, 2005, and Amadio et al, 2005, Elliot, 2002 and Pettengill, 2005, the latter three of which were cited in Tang, 2007).

In general, the recent literature dealt largely with early motion protocols, be it passive or active flexion of the fingers. The trend in current research seemed to be moving towards evaluating rehabilitation protocols involving early active flexion of the fingers. But the question remained as to how relevant these protocols were in the various South African settings, for example, district versus tertiary public hospitals, rural versus urban settings, private versus public practice.

The duration of rehabilitation was a matter under question. Adolfsson et al (1996) found no significant difference between completing a 10 week course of rehabilitation post flexor tendon repair, allowing full function at 8 weeks. Chan and Fung (2006) recommended a 7 week programme, yet their mean rehabilitative time period was actually 130 days.

Considering all of the above, and as Elliot et al (2005) and Tang (2007) suggested, post operative mobilisation regimes have been essential for the successful recovery after sustaining these type of injuries. Occupational Therapy and Physiotherapy have played a vital role (Bielecki and Lebowska, 2007).

Occupational Therapists have been becoming increasingly aware of supporting their practice with evidence. EBP demands clinical reasoning based on high quality research (Dawes et al, 2005b, Stegink Jansen, 2002). It should lead to a questioning mind set of why clinicians treat as they have been and whether this method was the best, most efficient method (Herbert et al, 2005b, Joubert, 2005). But the question remained: Has the knowledge they were basing their treatment methods on, been evidence based? (Dawes et al, 2005b, Herbert et al, 2005a, Watson and Buchanan, 2005) Therapists should not neglect to consult more experienced therapists who had *"intuitive feelings of what is right and wrong*" as they could provide a wealth of information that was not yet written up and published (Joubert, 2005: 11).

1.3. Significance of the study

Ultimately, this research would benefit the patient as it aimed to evaluate the current trend of therapy and thus would suggest trends that have been more popular because they were either more effective or appropriate given the South African context.

In addition evidence obtained through the study, could be built upon in future to determine what the best practice should be for flexor tendon rehabilitation so that it could be taught at an undergraduate level, as encouraged by Dawes et al (2005b), Joubert (2005), and Watson and Buchanan (2005). Further studies could be done to establish what evidence-based practice should be used for treatment of diagnostic groups handled by the hand therapist, and how effective the actual protocols selected were, for the South African population within its varied contexts, as encouraged by Joubert (2005).

Apart from publishing the work which would add to the existing knowledge related to this particular aspect of hand injury, the research could contribute information to assist universities in updating the under graduate curriculum of Occupational Therapy and Physiotherapy training in hand therapy (Watson and Buchanan, 2005). It could contribute to the updating of curricula for post graduate degrees in Hand Rehabilitation. It would be beneficial to hospitals

and clinics where large numbers of hand injuries were treated in that it could suggest protocols more suitable to their setting as well as to provide insight into the resources necessary to equip each to deal with their particular context.

1. 4. Aim of the study

The aim of the study was to determine which rehabilitation protocols Occupational Therapists used to treat clients who had undergone flexor tendon repairs, and to investigate the therapist's knowledge and views regarding these protocols.

1. 5. Objectives of the study

The objectives of the study were:

- To determine the nature of protocols, if any, that have been used by South African Occupational Therapists working in Hand Therapy in the treatment of clients with flexor tendon repairs
- To establish the therapist's knowledge of and preference for particular protocols, regardless of whether these have actually being used in clinical practice
- To establish reasons behind the OT's choice of protocol
- To establish whether protocol use differed across sites of practice within the South African context, and if so, why?
- To establish whether experience levels affected the choice of protocol

Chapter 2

Literature Review

This chapter will discuss the relevant literature related the various flexor tendon rehabilitation regimens as well as the role of evidence based practice.

2. 1. The pro's and con's of evidence-based practice

A hand therapist, using evidence-based practice, should integrate one's own clinical skills and knowledge with the best available data from systematic research. Evidence-based medicine, the term, was initially introduced in 1991 (the idea has been discussed since the 1970's according to Watson and Buchanan, 2005). It required that the decisions clinicians, (and patients alike), make were based on the latest, most valid and relevant, and best available research, within the environmental context of resources available to both parties. (Dawes et al, 2005b).

It was not only about bodies of research highlighting scientific approaches to health care, but additionally about translating the evidence into one's own clinical setting, implementing it into clinical practice and evaluating the effect (Stevens, 2001). Systematic reviews identified and evaluated relevant, high quality research. Experience has been invaluable and should not be under-estimated, but experience may not always represent the broader truth. EBP has been thus aimed at improving health care (Stevens, 2001) by providing health professionals with this broader truth that should, if it was properly applied, enhance their treatment interventions.

Hand injuries have often been given a low priority due to their status in emergency care, the cost of the care and the deficit of trained professionals (Dias et al, 2006). Dias et al (2006) highlighted the need for information, education, research and service infrastructure, stating that all professionals involved in hand injury treatment, needed to be properly educated, and the appropriate educational information needed to be widely distributed. Watson and Buchanan (2005) mentioned this in the general arena of Occupational Therapy. Organised care in treating hand injuries could be developed by doing national audits to obtain information about the type, frequency and degree of hand injuries as well as who needed this information. What were the controversies in treatment methods? Which regional units could take leadership to bring continuity of care into place on a national level? (Dias et al, 2006).

What has been considered a valid study? Has the study tried to discover an objective observation of clinical practice while avoiding the temptation to explain the findings? What about the populations chosen in the studies? Did they share similar characteristics or would they cause confounding results because of their diversity (Cardarelli and Seater, 2007)? Studies done outside of South Africa may not have been relevant to the South African population or context. Studies done in South Africa may have resulted in confusing conclusions as the population groups and health care settings varied so much, because of South Africa's strange combination of first and third worlds (Joubert, 2005).

Cardarelli and Oberdorfer (2007) emphasized the importance of the follow-up time period of studies that have been carried out. This has been especially relevant for flexor tendon injuries as functional improvements may have been seen gradually for the more severe cases but still, the client could return to a productive employment and lifestyle. The converse may similarly have been true: clients with "excellent or good" results of hand function after flexor tendon repair but may have lacked their previous dexterity or sensibility, required in their choice of occupation.

Although clinical guidelines may have been readily available to therapists (in files in their office or electronically stored on a computer somewhere), they may not have been accessed regularly. There was a tendency to peruse the guidelines or protocols in difficult cases (such as flexor tendon injuries) but once one had become familiar with the treatment methods, often clinicians felt the treatment methods chosen did not require changes. Where did therapists and other clinicians gain knowledge from? Networking had been a main source, as well as localised meetings, seminars and workshops (continued professional development). The dangers of networking, have been that opinions were often conveyed, as opposed to scientifically proven methods of treatment. (Gabbay and Le May, 2004). Yet was that always a bad thing? Joubert (2005) suggested the importance of the knowledge and skill of experienced therapists in guiding clinical practice. Thus, while essential to good practice, over dependence on research evidence may have hindered advancement in new discoveries elicited through experimentation in practice. As suggested by Visvanathan, cited in Joubert (2005: 9) who maintained that *"… pilgrimages usually begin in wonder, submission and faith, but modern science is a journey that began in doubt. In fact, doubt occupies in modern Western thought the same central position which wonder occupies in Greek thought. The history of Western thought has been a celebration of victories of doubt over common sense. The histories of the Copernican, Darwinian and Freudian revolutions has been the triumphs of doubting man. It*

was the sciences way of seeing, the lenses and maps it constructed and placed between itself and the world that rewrote the world." Watson and Buchanan (2005) mentioned developing OT EBP databases and catalogues to collaborate evidence within the OT context, and make it available though a sole source, available to clinicians and students alike, as well as integrating it into undergraduate and postgraduate curricula.

Lockwood et al (2004) documented a very good method of applying evidence to the clinical setting. They organised meetings where the chair would rotate each meeting. It was the chairperson's responsibility to select a topic and gather appropriate, high evidence articles, which were distributed and read by each attendee prior to the meeting. The chairperson would then summarise the discussion, document it and circulate it to all the staff, as well as make it accessible on their intranet and in their library. The purpose of the meeting was to analyse the articles and make conclusions appropriate to their specific setting, and where necessary, make relevant changes to clinical practice. Discussion time was vital and thus sufficient time was allocated, appropriate people were selected to read specific articles, staff at all levels were involved and encouraged to question, and subsequently everyone was integral in developing practice guidelines. Having staff at all levels of care, involved in the decision making process, increases staff cohesion and was likely to result in greater levels of consensus regarding treatment protocols.

Green (2004) commented on the importance of evidence over tradition, although the South African context has not always been conducive for research and the application of high quality research, or as Sackett et al (cited in Joubert, 2005: 8, and Watson and Buchanan, 2005: 14) defined EBP: "*the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients*". Watson and Buchanan (2005) mentioned that Australia, Canada, the United States of America and the United Kingdom have been fore runners in applying EBP to clinical services but South Africa, Brazil, Korea, Sweden, Taiwan, New Zealand and Israel had been improving student and clinician education regarding EBP.

Dr Martin Dawes (2005a) argued that the content of what one studies at university level was often out of date by the time one finished training, because, although textbooks were helpful in laying foundations of knowledge, the information was often several years outdated by the time they were published. Dawes (2005a) maintained that the volume of scientific research published doubled every decade, but that the research was not always of a high level of

validity. He emphasised the need to share critically appraised topics (CATS) within the profession. Watson and Buchanan (2005) suggested breaking down the elements of EBP into components that could be taught to undergraduate students and integrated and expanded in postgraduate curricula. They presented a concise summary in a table on page 18 of their article published in 2005, which suggests graded methods of integrating EBP skills.

Herbert et al (2005a: 3-4) in their discussion about the use of outcome measures to measure outcomes, maintained that this did not necessarily give an indication on the quality of intervention. They said that "*the empirical approach, in which clinical decisions are based on careful measurement of outcomes, is not evidence-based physiotherapy.*" (Emphasis mine). Audits of clinical outcomes could be helpful when there was minimal evidence, as per Herbert et al (2005a).

Harm could be caused when evidence has been ignored, or at the very least, an opportunity could be missed to benefit patients. (Dawes et al, 2005b). Due to the volume of literature available, one needed to sift and identify the good quality research papers. This research should be transferred into clinical knowledge and practical interventions.

Garner et al (2004) wrote an article about why evidence was often not put into practice – and how resources were wasted by ineffective methods used. A change of policy had not always translated into a change of clinical methods. High staff turn over created difficulties regarding changing practice and maintaining the change. South Africa may have the structure for change in the health care setting but resources and social interaction would be required. However, the lack of resources should not be an excuse for avoiding evidence-based practice.

Only a small percentage of health care professionals have kept up to date on current research, and even less have applied the evidence to their clinical practice, according to Siddiqi and Newell (2005). They said that knowledge of effective interventions in low resource settings was limited and thus often relevant research was not available.

Evidence to support clinical practice should be found, or developed, especially in cases where little research has been done. Where there was plentiful research, the highest level of research would be a double-blind randomized clinical trial. Smaller studies could provide valuable contributions, so long as the study design was of high quality and standardized outcome measures were used, specifically to answer the research question. (Stegink Jansen, 2002).

2. 2. Flexor Tendon Protocols

The Cochrane Database completed a systematic review on rehabilitation protocols for flexor tendon repairs, published by Thein, et al in 2010, but they withdrew it on the grounds that it was out of date. Unfortunately there was no current Cochrane systematic review or meta-analysis but the withdrawn one did provide some valuable information, albeit "out of date". They referred to flexor tendon protocols as a post operative rehabilitation period requiring initial immobilization followed by mobilization of the injured fingers, with each phase of rehabilitation being varied according to the various protocols. Their review found insufficient evidence indicating (in randomised controlled trials) which rehabilitation method of mobilization was the best. No significant differences were found in terms of complications and in terms of success of the rehabilitation.

These various methods of rehabilitation have been discussed below. They have been presented according to the perceived progression of rehabilitation protocols, namely beginning with immobilization, followed by various passive motion protocols and finally ending with the newer developments in active motion protocols.

2. 2. 1. Immobilization

There was very little current literature regarding immobilization protocols for treating flexor tendon repairs, largely due to the fact that immobilization for sustained periods of time has been proven ineffective. However, it could be beneficial in certain circumstances, as stated by Hunter et al (2002), for example for children, patients with mental incapacities and the inability to follow a programme, the unwillingness to complete the rehabilitation process, or because of delayed referral from the doctor. Stewart Pettengill and Van Strien, who authored the chapter in Hunter et al (2002) on flexor tendon post operative management, described the immobilization protocol as total immobilization in a splint with the wrist in 10°-30° flexion, the MCPj's in 40°-60° flexion and the IPj's in neutral or 0°, for 3-4 weeks, with possible therapeutic intervention to provide passive range of motion exercises, controlled by the therapist, on a weekly basis, if possible. Then, from week 3, week 3.5 or week 4, the splint should be modified to bring the wrist in to a neutral position, but continued to be worn until 6 weeks, and active differential tendon glide exercises should be introduced on an hourly basis.

From 6 weeks, blocking exercises should be introduced and gradually resistance and grip activities should be introduced from week 7 or 8, depending on the patient's progress. Return to heavy work was expected at 10-12 weeks.

Some older articles have done studies on this protocol, for example in 1992, Stanley and Tribuzi described this method as placing the patient (often used for children) in the same kid of splint, as mentioned above, with the wrist in 10°-30° flexion, the MCPj's in 40°-60° flexion and the IPj's in neutral. They did not state the time period thereof, but did recognise the risks of joint stiffness or contractures developing, which has been noted in more current literature as a common complication, and thus advised removal of the cast during therapy sessions for passive mobilizations. They mentioned a study which showed that at 3 weeks post repair, the immobilized flexor tendons were half as strong as mobilized tendons, and at 12 weeks post repair, they were only 20% as strong as that of a normal tendon, whereas the mobilized tendons were 50% as strong.

Another older article by Shear and Bear-Lehman, published in 1989, compared the benefits of mobilization versus immobilization post Zone II flexor tendon repairs. As mentioned previously current research on immobilization was difficult to find, as many authors recognise that a form of early mobilization has become the preferred method. Shear and Bear-Lehman (1989) only immobilized the hand for 3 weeks post operatively. The Kleinert regime, the Duran and a combined active and passive programme were compared with the 3 week immobilization programme. They stated that one of the main reasons for differences in opinions regarding post operative protocols, was whether tendon healing was intrinsic or extrinsic. In other words, if a tendon healed intrinsically, then the tenocytes within the tendon sheath were essential for healing and required the nourishment of the tendon sheath. If a tendon healed extrinsically, the nourishment came from elsewhere and thus adhesions would be essential in the healing of the tendon. However, according to a 2005 International Federation of Societies for Surgery of the Hand (IFSSH) flexor tendon committee report (Elliot et al, 2005), tendon healing occurred extrinsically, by means of sufficient vascular supply and some adhesion formation, and intrinsically, by mechanical means, such as ultrasound. They stated that closure of the sheath was not considered necessary anymore. They commented that "*twenty years ago, immobilization was a popular approach, in spite of the growing evidence supporting early mobilization*" (Elliot et al, 2005: 110). Shear and Bear-Lehman (1989) were already

debating the necessity of adhesion formation although some authors advocated it to assist with healing and to provide a physical support for the repaired tendon.

However, when Shear and Bear-Lehman (1989) talk about studies done more than 20 years ago, with regard to immobilizing the tendons, it was often only for a few days. Longer immobilizations tended to result in more adhesion formation and thus compromised function. Young and Harmon (1960), as cited in Shear and Bear-Lehman (1989) showed that research was already beginning to pay attention to the fact that tendons became stuck down in the scar tissue mass after prolonged immobilization. This appeared to be mark the introduction of controlled passive mobilization on the first day post operatively. Lister et al (1977), cited in Shear and Bear-Lehman (1989) found that a 3-5mm extension excursion of the tendon from controlled mobilization, was sufficient to prevent firm adhesions forming in Zone II repairs. Shear and Bear-Lehman (1989) said that early controlled mobilization showed a stimulation of intrinsic healing, and that after 3 weeks of immobilization, there was no significant change in DNA or tendon vascularity, but mobilization resulted in an increase in DNA content in the sheath and tendon repair site and a more normal reorientation of the blood vessels.

Elliot et al (2005) commented that even experienced therapists may have at times immobilize patient's with flexor tendon injuries for 3-4 weeks. For example, in the cases of young children, those with associated injuries, patients who were unable to comply with a home programme or when sufficient supervision or direct treatment sessions was not possible. Mennen and Van Velze's textbook published in 2008 supported this.

In the review of the literature, the researcher found that protocols were generally divided into passive or active motion protocols. Passive motion protocols generally included the Duran Programme where the finger was passively flexed and passively extended according to certain criteria within the respective weeks post operatively. Active protocols were generally classified as those that allowed active extension of the fingers whilst the flexion was passive, mostly by means of a pulley system, for example the Kleinert Programme (Shear and Bear-Lehman, 1989). Early Controlled Motion (ECM) Protocols generally dealt with active flexion and extension according to weekly criteria (Elliot et al, 2005). The researcher found these terms often deceptive as one would read an abstract about an active regime only to find out upon reading the article that the motion was not active in flexion but only in extension. It appeared that researchers tended to name the protocols with pulley systems (dynamic splints) as active

(active extension), whereas active flexion of the tendons was not considered. Interestingly, it had recently been a trend to use active flexion and extension of the finger with the repaired tendon.

2. 2. 2. Passive mobilization protocols

The most commonly known passive mobilization protocol has been the Duran regime, and as Elliot et al (2005) stated, it has often not been used as strictly prescribed. Hunter et al (2002) have classified the Duran and the Kleinert as passive mobilization protocols, interestingly, as many authors have referred to the Kleinert as an active mobilization protocol. Both these protocols have been laid out in detail at the end of this section, and just before *passive flexion and active extension mobilization protocols*. They described both protocols as having a traction system, in the dorsal protective splint – similar to that described above under the immobilization protocol, but they stated that the Duran and Houser method used the dynamic traction to rest the finger in flexion (and removed for passive mobilizations), whereas the Kleinert programme used the traction system to resist finger extension. However, they stated that the Modified Duran method, which has been more commonly used, was without the traction unit, still incorporating the passive flexion and extension exercises. Their description of the Duran, included the tenodesis cuff at 4.5 weeks, with resisted grip activities commencing at 7.5 – 8 weeks.

A textbook by Stanley and Tribuzi, (1992) talked about "Early Controlled Mobilization" as passive protocols. This could have been confusing to readers who were referencing current literature where early active mobilization (EAM) methods or early controlled mobilization (ECM) protocols included active flexion of the fingers.

A Turkish article, by Kayall et al (2003), spoke of how they did a flexor tendon study on children under the age of 14 years old. Most cases were operated on within 24 hours, all tendons were repaired using the modified Kessler suture technique, and a splint was applied to the hand, forearm and above the elbow, which was appropriate for small children. The Duran technique was implemented on day 1 post operatively. Strickland (and Glogovac)'s criteria was used for evaluation – described below in Table 1. The results were excellent in 18 fingers, good in 5, fair in one and poor in one, which showed that passive mobilization post primary repair in children resulted in satisfactory outcomes.

Libberecht et al (2006) evaluated various methods of functional assessment of the hand post tendon repair. They found that the Original Strickland classification (see Table 1 below) revealed similar results to the TAM (Total Active Motion), of which the latter was recommended by the American Society for Surgery of the Hand. They found the Disabilities of the Arm, Shoulder and Hand (DASH) assessment to provide insufficient information. Libberecht et al (2006) additionally assessed grip strength using a Martin Vigorometer, recommended by the American Society of Hand Therapists, although they used a Jamar Pinch Gauge to evaluate tip pinch grip, which had a slight correlation to the DASH outcomes. Riaz et al (1999) likewise made use of the TAM, as well as grip strength with the Jamar Dynamometer, for evaluation of long term outomes. Tiller et al (2008) found that joint range of motion was more affected than grip strength post tendon repair in a medium term follow up period (11-22 months) but that work reintegration was not problematic.

Table 1: Strickland's classification- assessing flexor tendon repair results

(PIP+DIP) flexion – (PIP+DIP) extension deficit x 100 / 175 = % of normal active PIP + DIP motion				
	Strickland's original classification		**Strickland's modified classification**	
Results	**%**	**Degrees**	**%**	**Degrees**
Excellent	85-100	(150+)	75-100	(132 +)
Good	70-84	(125 – 149)	50-74	(88-131)
Fair	50 – 69	(90 – 124)	25-49	(44-87)
Poor	< 50	(< 90)	<25	(<44)

An article, submitted for publication in 1959, by Young and Harmon, brought to light some earlier thinking regarding flexor tendon rehabilitation. They stated that in the past, absolute immobilization for at least one week, was the accepted method of treatment, but that they had already moved away from this. They gave an interesting history of how before World War I, repair of tendons usually resulted in unsatisfactory results. They referenced an even older article by Bunnell (1940), who said that antibiotics improved repair results and that strong antiseptic chemicals were being used instead of saline irrigation. Differences between the approach in treating extensor and flexor tendons were becoming apparent and it was recognised that every incision and stitch resulted in some degree of functional limitation. Mason and Allen (1941), cited in Young and Harmon (1959), demonstrated that tensile strength of the tendon diminished from day 3 to day 7, thereafter, it increased in strength.

They found a mass of adhesions formed when tendons were immobilized for a period of time (but they did not specify how long!). They made use of a rubber band pulley system, much like the mechanism of a fishing rod, to avoid sudden movements or spasms of the fingers, allowing the finger to rest in a flexed position (similar to what was later described by Kleinert, who has been referenced in various articles). The rehabilitation protocol used incorporated passive extension of the finger with release, allowing the rubber band to passively pull the finger back into flexion. This motion was increased daily, with full range of motion permitted at 3 week. No active movement was allowed until after 3 weeks, when the rubber band was removed and full active flexion and extension was encouraged. Young and Harmon (1959: 565) said "*Physiotherapy was rarely necessary*" but did not elaborate on what they meant by that statement – thus one may have deducted that the rehabilitation was surgeon led and physiotherapy was only required for problem scenarios. Their results were satisfactory, although no standardized evaluation criteria were used to establish this. One of their main focuses was on return to work and thus minimal workman's compensation being paid out. This appeared to be a great advancement in flexor tendon protocols, moving away from immobilization towards early mobilization.

Zhao et al (2005) did an interesting study on dogs, to look at the short term outcome of mobilizing a repaired tendon from either day 1 or day 5. Their results showed a favouring for mobilizing rather from day 5, as gliding resistance was lower. This time period appeared to provide the "*widest margin of safety between the tendon's breaking strength and the load required to initiate tendon gliding within the sheath*" (Zhao et al, 2005: 323). They had no tendon ruptures in the group that began mobilizing on day 5, but in the group that began mobilizing on day 1, they had 8 tendon ruptures from 4 dogs (of which 3 tendons were repaired or randomised for a sham repair). The study was performed over a 10 day period. There were no significant differences in resistance for maximum breaking strength or for gap formation between the two groups. This was a passive mobilization protocol, which acknowledged that the force applied only needed to overcome the internal gliding resistance and not the resistance of antagonist muscles, as in an active mobilization protocol. Zhao et al (2005) emphasized the importance of communication between the therapists and surgeons to achieve good results, when mobilizing within the first week post repair.

Elliot et al (2005) mentioned that even some experienced therapists in the United States of America used a passive mobilization protocol, when others may have been preferred, if

conditions were not conducive to direct supervision and regular therapeutic contact. They commented that in Zone I and II repairs, pushing to achieve full passive flexion in week 1 could be painful and difficult to achieve, however that by week 2, full passive range of motion should be achieved. This was to reduce the effect of load on the repaired tendon.

The Duran protocol (a passive mobilization protocol, and the Kleinert protocol (a passive flexion with active extension protocol) have been set out in detail below. (Shear and Bear-Lehman (1989), with adaptations, from Cannon, N.M. (1984). *Flexor tendon repair - Zone IL Manual on management of specific hand problems* (pp. 44-47). Pittsburgh AREN.)

Duran—Controlled Passive Mobilization (also known as the Duran and Houser method)

- Day 1-3: Immobilization of the hand in the dorsal protective splint.
- Week 1-4.5: Exercises, repeated hourly (in or out of the splint, but splint worn at night and all other times), namely: 8 repetitions full passive flexion and extension of the proximal interphalangeal joint (PIPj), 8 repetitions of full passive flexion and extension of the distal interphalangeal joint (DIPj), 8 repetitions of passive composite flexion and extension of all finger joints, passive mobilization of the uninvolved fingers to avoid stiffness.
- Week 4.5: To continue with the above passive exercises and to include: 10 repetitions of active wrist and finger flexion, followed by wrist and finger extension, 10 repetitions of composite active flexion and extension of all finger joints. To continue with the splint.
- Week 5.5: Discontinuation of the splint and increased exercises, to 12 repetitions of active wrist and finger flexion, followed by active wrist and finger extension, 12 repetitions of composite active finger flexion and extension, 12 repetitions of PIPj blocking exercises (held for 5 seconds), 12 repetitions of DIPj blocking (held for 5 seconds).
- Week 6: Passive extension of the fingers and wrist to be allowed, reverse volar splinting, if needed, active and passive exercises, with blocking exercises each hour.
- Week 8: Graded strengthening.
- Week 10: Return to heavy labour duties, sports and other heavy resistive exercises (all other exercises and splints to be continued or adapted according to the patient's progress).

Kleinert—Controlled Active Motion (active extension with passive flexion)

- Day 1-3 post surgery: Immobilization of the hand in dorsal protective splint and dressings to be removed from the fingers to allow passive flexion to palm in the splint. An elastic

band to be attached to finger nail(s) of the finger(s) that have been repaired, and placed near wrist level on the volar aspect of the forearm, for example on a Velcro strap.

- Week 1-3: Active finger extension against the elastic band but allowing the elastic band to passively bend the finger 10 times every hour.
- Week 3: Splint to be removed.
- Week 3-6: The patient's hand to be kept in a wrist band or tenodesis cuff with an elastic band traction fitted to each finger to allow full active extension of interphalangeal and metacarpal-phalangeal joints against the elastic band with wrist in flexion or neutral. All exercises to be done with the splint on and no active finger flexion allowed.
- Week 6: Tenodesis cuff to be removed and active flexion to begin, as well as tendon-gliding exercises and blocking exercises.
- Week 8-10: Graded strengthening to begin, followed by isometric / sustained grip activities.
- Week 12: Return to heavy labour duties and other heavy resistive exercises.

(Information obtained from Shear and Bear-Lehman (1989), who used it with adaptations, from Cannon, N.M. (1984). *Flexor tendon repair - Zone IL Manual on management of specific hand problems* (pp. 44-47). Pittsburgh AREN.)

2. 2. 3. Passive flexion with active extension protocols

Elliot et al (2005) discussed this protocol in detail in the IFSSH flexor tendon report. They commented that since Kleinert's publication in the 1960's, early mobilization was favoured throughout Europe, by means of dynamic dorsal splinting for 3 weeks and then the use of a wrist strap or tenodesis cuff for week 4-6. Currently, the splint tended to be used for longer than 3 weeks, often as much as 6 weeks. They commented that the Kleinert regime, in reality, battled to achieve sufficient distal interphanageal joint (DIPj) flexion and often resulted in proximal interphalangeal joint (PIPj) flexion contractures. They were of the opinion that the idea of achieving passive flexion of the fingers by means of a rubber band, was not clinically the case. Patient's found it difficult to relax and had a fear of pain, and thus some active flexion often occurred. The tension of the rubber band was greatest at end range and thus full extension of the finger was often not achieved. Even though this regime had been called an early mobilization regime, they stated that it should rather be known as an active extension/assisted flexion regime (as opposed to an active extension/passive flexion regime).

In fact, they labelled it a passive mobilization method, with traction, and the Duran method was a passive mobilization method without traction.

Saini et al (2010) used a modified Kleinert method for their rehabilitation protocol, which they described initially actively flexing the finger, followed by passive flexion as per the Kleinert regime. They reported a 3% rupture rate. They began rehabilitation within the first day post surgery and found that delays in surgical repair directly affected their rehabilitation results.

Chesney et al (2011) found in their systematic review comparing rehabilitation protocols in 79 articles spanning 1970 – 2009 (of which 15 met the inclusion requirements), that a combination of the Kleinert-type protocol (passive flexion and active extension) with the Duran type protocols (controlled passive mobilization) resulted in the lowest rupture rates (2.3%) but that rupture rates were the highest in Kleinert-type protocols (7.1%), although no statistical significance was found. They found that the combined Kleinert and Duran methods, as well as the early mobilization protocols (to be discussed below) resulted in the highest percentage of fingers with good or excellent results, according to the Strickland system (see Table 1, page 17).

Galanakis et al (2003) maintained in their research that an early protected mobilization programme, which included unrestricted movement of the interphalangeal joints (IPj's), with close monitoring offered the best chance of achieving optimal hand function post Zone II primary flexor tendon repair. Surgically, they preserved the pulleys and repaired both the Flexor Digitorum Superficialis (FDS) and the Flexor Digitorum Profundus (FDP) with a modified Kessler (2-strand core stitch) and a circumferential stitch. They used a dorsal splint from the elbow to the finger tips, with the wrist in 30° flexion, and the metacarpal phalangeal joints (MCPj) in 70° - 90° of flexion, and allowed unhindered extension of the fingers. The patients were instructed to passively mobilize their fingers into flexion and then actively extend the fingers on the third, fourth or fifth day postoperatively. The passive mobilization was done by first passively flexing the DIPj and then the PIPj, and finally the MCPj. This was repeated every hour to hour and a half, each day. This was monitored and by six weeks the splint was removed and an active flexion and extension programme (each joint separately, while blocking the other joints) was introduced. Eight weeks post surgery, light activity was allowed and full activity was permitted at 10-12 weeks, including strengthening. At 12 to 35 weeks (mean being 20 weeks) an evaluation was performed and Strickland's original grading system was used

(Galanakis et al, 2003). Of the 22 cases, the results were scored as 15 being "excellent", 5 "good" and 2 "fair" – one of which became infected. All the subjects returned to work between the 10th and the 12th week.

Galanakis et al (2003) advocated early passive mobilization postoperatively to prevent unnecessary adhesion formation, rapid healing and good gliding of the tendon, ultimately resulting in a stronger repaired tendon. They emphasized the need for the surgeon, the therapist and the patient to have a good relationship where time was spent explaining problems and the importance of rehabilitation, so that increased compliance could be achieved, as did Zhao et al (2005).

Kitis, et al (2009) compared the modified Kleinert method (Washington protocol) which included dynamic splinting, active extension against the traction unit, with passive flexion with passive mobilization protocols. In the modified Kleinert group, they found 87% (119) achieved excellent range of motion results according to similar measurement tool to the Strickland system, the total active movement (TAM) measurement whereas 75% (94) achieved excellent results in the controlled passive mobilization group. Their modified Kleinert group achieved 89% grip strength as compared to the non-injured side, whereas the passive mobilization group achieved 81% grip strength. All measurements were done 12 weeks post surgery. They advocated the dynamic splinting method with controlled active extension mobilization.

Chow et al (1988) likewise made use of the type of Kleinert regime, called the Washington regime – involving controlled active extension of the finger against a rubber band pulley, which caused passive flexion. They referenced Kleinert et al (1967) and Lister et al (1977), who originally advocated this method, as well as Duran and Houser (1975) and Strickland and Glogovac (1980) who made use of controlled passive mobilization protocols. Their method was to apply the rubber band pulley, allowing active extension and passive flexion, for 4 weeks. They incorporated passive extension in the splint in this period to prevent flexion contractures of the PIPj's (which had been a common short fall of the Kleinert regime and Chow et al's (1988) main problem in their discussion section). During the 5th and 6th weeks, active flexion of the fingers was commenced. The splint was removed at 6 weeks and mild resistance exercised was incorporated at 8 weeks. They once again used Strickland's criteria for evaluating the results and 62 fingers (80%) scored an "excellent" result. 3 tendon repairs ruptured. Chow et al

(1988) advocated early active mobilization of tendon repairs to avoid adhesion formation, although they only began active flexion of the fingers at 5 weeks.

Similarly, Chan and Fung (2006), did a study on mobilizing the repaired flexor tendon by using a rubber band pulley that allowed passive flexion/active extension of the fingers and externally applied passive flexion and extension of the fingers in the splint. They reported they began "immediate" controlled finger mobilization with the pulley, to prevent adhesion formation. They used the Kleinert type splint for 3 weeks and then removed it in week 4-5, allowing active flexion of the fingers. They incorporated resistance during week 6 and 7. Only one (4.8% of the sample) repaired tendon ruptured and adhesions occurred in 2 (9.6%) of the cases. However, only 57% (12) of the sample scored an "excellent" result and the average rehabilitation period was 130 days or just over 4 months, which could be considered very long, but they did include patients with neurovascular injuries in the study, and attended to the re-strengthening of the repaired fingers, which may have resulted in the more lengthy rehabilitation period.

May et al (1992) incorporated a night extension splint to overcome the possibility of flexion contractures developing due to the dynamic pulley system they used, as a modification of the Kleinert regime. Similarly, they made used of passive mobilizations. Their programme proved safe, reliable and cost effective.

There were many other studies along similar veins, advocating the Kleinert type regime of early passive flexion of the fingers with active extension against a dynamic pulley system. Some found that better results were achieved when using the Kleinert protocol, with young, motivated patients, and that delayed repaired tendons did badly with this type of protocol, especially in Zone II, but generally these articles advocated the Kleinert-type protocol. (Earley and Milward, 1982, Baktir et al, 1996, Edinburg et al, 1987.) It was noted in the literature that delayed repairs, grafts or secondary repairs had worse outcomes and were often excluded from studies, or affected the results, as in the case of the study done by Hung et al (2005). Clients with these type of injuries / surgical interventions would require a longer rehabilitation time, as seen in study performed by Chan and Fung (2006)

Cetin et al (2001: 721) compared the used of the Kleinert with the Duran protocols and then did a study that used a combination of the modified Kleinert and modified Duran, and

concluded that "*patient-assisted passive exercises are very safe and more cost effective than therapist-assisted passive exercises.*"

2. 2. 4. Active mobilization protocols

Tanaka et al (2005) did a study on the tension on FDP in human cadaver hands, to establish what position of the wrist and IPj's was the safest to mobilize the hand. They recognised that early mobilization (active or passive) was a method that was being introduced within a few days post operatively – a development from the previous decades of rehabilitation protocols. This produced better results than immobilization, as it produced less adhesions and improved the strength of the repair, by promoting intrinsic healing and synovial diffusion. Tanaka et al (2005) acknowledged that safety of early mobilization was the main concern, as well as the argument as to the effectiveness thereof. Their problem with passive mobilization was that even though the finger moved, the tendon may not have been able to overcome internal resistance and thus not actually have glided. Their concern with active mobilization was gaping of the repair site, should the mobilization have been too aggressive. Having said this, they stated that passive mobilization techniques were considered better than immobilization and have been safely used for many decades. Active mobilization reduced the chance of the tendon buckling in the sheath.

For this reason, Tanaka et al (2005), in their study, positioned the cadaver hands in various positions, by using external fixators and markers, and the tension in the FDP tendon was calibrated electronically, in Neutons. The digit was manipulated in various movement patterns and configurations, taking about 20 seconds; each cycle being repeated three times. The calibrations were read on the third cycle, as the first two were considered preliminary. Their results showed that the average tendon excursion of FDP in Zone II was 20.9 $\pm$ 2.6mm. The position of the wrist, interestingly, had the most significant effect on the tension in the tendon, with flexion resulting in considerably lower tension than when the wrist was extended. The MCPj position had a considerable effect on the tension. They found that resistance of uninjured FDP tendons within the A2 pulley (Zone II) was roughly 0.3N but that this tension increased to 1.1N after repair. 7N was the force required to produce gaping of the repair site, which was a force only acquired with significant strain, and the wrist and MCPj's in full extension. But this study did not account for stiff joints and resistance from tendon oedema, synovial sheath, pulley and other factors.

No resistance was found by Tanaka et al (2005) during synergistic motion, specifically when the wrist was extended and the fingers were fully flexed. The hook fist position, in other words; the wrist extended, the MCPj's hyperextended 45° and the IPj's flexed, resulted in tension on the tendon of 1.77N, which was still considered safe for mobilization. They recommended a movement sequence of 1) wrist flexed in 60° with the MCPj's and the IPj's fully extended, followed by 2) passive flexion of the fingers with the wrist still flexed in 60°, followed by 3) gradual extension of the wrist to 60°, still with the fingers fully flexed, and finally 4) gradual extension of the MCPj(s) to 45° with the IPj's still flexed. One then reversed the sequence to return to the starting position. They advocated this method for mobilization post FDP repair. Some authors have named this synergistic wrist movement (Tang, 2007). Other therapists and surgeons have used a modified method of this and named it the tenodesis effect or action (Stanley and Tribuzi, 1992). Tenodesis has been described as passive extension of the fingers when the wrist was flexed and passive flexion of the fingers when the wrist was extended. It was apparent in literature that some authors used the terms interchangeably and not strictly true to their definitions.

In the systematic review of flexor tendon rehabilitation protocols, done by Chesney et al (2011), they found that early mobilization protocols and the combination of Duran and Kleinert techniques, resulted in the best results for finger range of motion, proportionally to their study size, and had low tendon rupture rates. They were not, however, able to include standardized quality of life scales as part of their results as many studies did not make use of them.

Stanley and Tribuzi's (1992), promoted active mobilization as a protocol that only allowed active flexion of the fingers from week 3-4, but if motion was easily achieved, it should be delayed by another week. They recommended blocking exercises and "place-hold exercises". They felt strongly that inexperienced therapists should not attempt to test whether the tendon was intact or not. Whereas, Mennen and Van Velze (2008), recommended place and hold exercises to begin from day 3-5, in conjunction with passive range of motion, and gentle active flexion to only begin once the tendon has healed or at about 2 weeks. They similarly suggested the use of synergistic movements as described above. From week 5, they suggested the splint be removed for washing of the hand, but the position of the hand should be maintained during this activity, and full active motion of the fingers was allowed, but not to passively

stretch the fingers into extension. Tendon gliding was introduced at week 6 and thereafter, the splint was weaned.

Braga-Silva and Kuyven (2005) did a study on an early mobilization regime that incorporated immediate (12 hours after tendon repair) active flexion and extension post Zone II flexor tendon repair, confirming the trend for rehabilitation and motion to begin earlier than in previous decades. They achieved a 72.2% "excellent" score, according to Strickland's criteria out of a sample of 82 patients, with 136 tendon repairs. Their aim was to reduce adhesions forming and joint stiffness by achieving tendon excursion early. The pulley structures (A2, A3 and A4) were preserved and fingers with associated injuries were not included in the study. Their rehabilitation regime included 10 repetitions of the active exercises every hour in a 16 hour period. The splint (which held the wrist in "30°-60°" flexion, the MCPj's in 90° flexion and the IPj's in full extension) was removed in the third week. Follow up period was between 12 and 36 months Their results showed "better outcomes" than immobilization regimes and other mobilization regimes but there were ruptures of tendons and gap formation occurring in repairs, (which results in the client not being able to make a full fist). These two reasons, primarily the former, have been significant contributors towards why EAM regimes were not widely accepted by surgeons. Manske (1988), cited in Braga-Silva and Kuyven (2005) said that mechanical stress on the tendon promotes collagen fibres restructuring, increased tensile strength and lessened adhesion formation, due to the intrinsic tendon activities that were stimulated by this activity.

Tang (2007), in his review of flexor tendon post operative rehabilitation, likewise mentioned the problem with tendon adhesion in regimes such as the one which Kleinert et al advocated in 1967, as well as the regime of Strickland and Glogovac in 1980, and others. (The Strickland protocol had been described as the Cannon protocol, which made use of "place and hold" methods of active mobilization, and was published by the Indiana Hand Centre, according to Hunter et al, 2002. Thus it was known by some as the Indiana protocol.) The enormous amount of literature had still not yet provided a treatment method with predictable, satisfactory outcomes. EAM, incorporating active flexion of the fingers, was becoming a more dominant protocol choice (Amadio et al, 2005, Baktir et al, 1996, Elliot, 2002 and Pettengill, 2005, all cited in Tang (2007). Tang (2007) advocated a change of the traditional protocol; to continue as most rehabilitation protocols suggested, with a splint in wrist flexion of 20-30° and IPj's in extension, with the MCPj's in slight flexion, incorporating active flexion (one third or

half of full range) and extension of the fingers in the splint, including passive flexion of the fingers, beginning at day 3-5, and continuing until week 2.5. Thereafter, the splint was changed to incorporate wrist extension of 30°, and the active and passive exercises continued. This change was done to focus on preventing finger extension deficits and due to the fact that the finger flexion movement was under less strain when the wrist was in extension – ie the tenodesis principle (Savage, 1988, cited in Tang, 2007, and Tanaka et al, 2005). At 5 weeks, full active and passive flexion and extension of the fingers was encouraged and the splint was discontinued or used only at night, from week 5 or 6. Tang (2007) attributed more importance to the surgical release of the pulleys and the rehabilitation process than how strong the surgical repair of the tendon was.

Hung et al (2005) advocated that early mobilization reduced tendon adhesions and stimulated tendon healing. They acknowledged the approaches of Kleinert et al and Lister et al, in using the dynamic pulley system in the splint to mobilize the repaired tendon but that finger flexion contractures were the disadvantage of these protocols, which was similarly recognised by May et al (1992). They were concerned about the lack of differential gliding between FDS and FDP,Hagberg, 1991, and Silverskiold, 1992, both cited in Hung et al (2005), maintained that differential glide could not be achieved simply by passively mobilizing the fingers. Hung et al (2005) positioned the patients in a splint with the wrist in 40° flexion and the MCPj's in 70° flexion, with IPj's in full extension, post repair. They began controlled active mobilization from day 3, supervised by an "experienced therapist" (although this was not defined), with graded flexion from 30°, being gradually increased, as well as tenodesis of the wrist and hand, out of the splint. Hung et al (2005) mentioned that wrist action was another means of achieving tendon gliding, as well as reducing hand swelling and joint stiffness. In week 4, the splint was changed to allow a neutral position of the wrist and gradually resisted mobilization was included. After 6 weeks, resistance and strengthening exercises was added. Although Hung et al (2005) confirmed that, as per various prospective and comparative trials, results for actively flexing and extending the wrist and fingers early in a mobilization protocol, achieved good results, they acknowledged that active mobilization would not be successful if the surgical repair was unsatisfactory.

Some hand surgeons have attempted to pioneer new methods such as Sántha et al (1998) and Savage et al (2005) who devised their own splints. Authors have tried various combinations of

the protocols and still no consensus has been reached as to which could be considered the gold standard (Chambon et al, 2001, Cetin et al, 2001).

The IFSSH flexor tendon committee report (Elliot et al, 2005) stated that the most significant change to flexor tendon regimes occurred in the last 15 years, with active flexion and extension protocols, beginning with Small et al's development of the Belfast regime. This regime was commonly used in the United Kingdom, and was cost effective and "user-friendly". It was perceived to be a risky protocol, as active flexion may place more strain, or tension, on a surgical repair than passive mobilization would, but the rupture rates were around 5% - the same as that of the Kleinert regime. They referenced Savage's studies (one of the authors – not a dated reference) that showed that active flexion of the fingers, with the wrist in extension of 20°-30°, required the least effort, yet clinicians were still inclined to resort to older methods of rehabilitation. They recommended a six strand repair that had been shown to be proportionally stronger than the two strand technique, and that a circumferential stitch added strength to the repair. In the United Kingdom, it was recommended that the splint allowed no more than 20° wrist flexion, although it did not seem to be of critical importance what position the MCPj's were in – the range was 45° to 80°, averaging out at about 60°. In the United States of America, there seemed to rather be a trend to position the wrist in the splint, as close to neutral, whereas, twenty years ago, they were placing the wrist in 30° flexion. However, to reduce the tension when flexing the fingers with the wrist in flexion, some would splint the wrist in slight extension. It was generally accepted that the IPj's were allowed full extension.

Elliot et al (2005: 110) noted a trend towards EAM protocols in the United States of America, stating that "*experienced hand therapists who keep current with the literature express a preference for early active mobilization."* These therapists would commence aggressive active flexion should a patient have minimal tendon glide at week 3 and 4. Some, however, had varying definitions of what exactly active flexion was: some used the terms "place-hold" or "active-hold" or "early active flexion", which was understood to be passive flexion of the finger followed by active contraction of the muscle to hold the finger in this position. Some used the proximal pull of tenodesis to achieve tendon excursion, and some used straight forward active flexion of the fingers in the therapy session, with or without an active flexion home programme. The Strickland or Cannon protocol incorporated "place-hold" or "active-hold" within the splint (wrist position in 20° flexion, MCPj's in 50° flexion and the IPj's in neutral) for 7-8 weeks but

this protocol used passive mobilizations such as described by Duran, in conjunction with tenodesis movements (Hunter et al, 2002).

In summary, as Hunter et al (2002) stated, it has been found that early mobilization of the tendon, in other words by passive mobilization, was not as effective as mobilization of the tendon with tension on the repair, which was achieved through active contraction. They said that EAM should be used for alert and motivated patients who have insight into the protocol. Variations of the active mobilization protocols have been described and should be executed by an experienced therapist who could be able to adapt it as required for the specific patient and related injuries.

Chapter 3

Methodology

This chapter will describe the study design, study population and sampling, data collection methods and data analysis, as well as ethical considerations.

3. 1. Research Question and Design

The research question was:

- what flexor tendon rehabilitation regimes are OT's in South Africa using and why?

This research followed a quantitative, positivist paradigm using a descriptive survey and a non-experimental design.

3. 2. Sampling procedure

The population consisted of Occupational Therapists, working in South Africa, in the physical field of practice who were paid up members of the societies and registered on databases, namely, SASHT (South African Society of Hand Therapists - 102 members) and OTASA (Occupational Therapy Society of South Africa - 1600 members). There was overlap but not all OT's who treated patients with hand injuries, were members of both the SASHT and OTASA societies. Many of the respondents from OTASA replied to say they no longer practiced, or practiced in a field other than hand rehabilitation, and the questionnaire was not applicable to them.

A purposive saturation sampling technique was used to select two distinct sample groups, out of the total number of respondents (N = 32), viz

- OT's who splinted and mobilized patients with hand injuries, working in various private sector locations(n=26) and
- OT's who splinted and mobilized patients with hand injuries, working in the public sector (n=9).

The total number was greater than the sample group as some therapists worked in both public and private sectors. The division between public and private sectors was implemented in order to establish any differences in use of protocols that may exist between the two groups. In

some cases, analysis was done dividing the groups into the therapists in private, public and those working in both sectors.

Recently qualified therapists (community service OT's) were included in the public sector grouping, as they have recent and immediate knowledge which may throw light on and influence clinical decision-making despite their limited experience and therapeutic practice / skill.

Inclusion criteria for this study thus consisted of those Occupational Therapists, who:

- worked in government departments, Non-Governmental Organisations or private practices where they have contact with patients with flexor tendon injuries
- worked with clients who have had flexor tendon injuries
- utilized splinting as a therapeutic intervention for clients
- were junior therapists, community service therapists or senior therapists in order to obtain a range of information across various phases of experience
- were sufficiently proficient in English in order to complete an English self-administered questionnaire.

Exclusion criteria for this study consisted of:

- Occupational Therapists who may have treated hand injury patients but did not manufacture splints or supervise the manufacturing of splints for clients.
- Occupational Therapists who had less than 6 months experience in a part time capacity, of treating clients with hand injuries.
- Physiotherapists who treated clients with hand injuries and may or may not have manufacture splints for these clients.

3. 3. Data gathering instruments

A structured self-administered questionnaire, with a consent form, was used to gather information from the sample (see Appendix 2). This included an introductory letter to the participants, (as well as OTASA and SASHT, and the University Occupational Therapy Heads of Department, see Appendix 3), explaining the purpose of the study and confidentiality

issues. Clear instructions were provided in the beginning of the questionnaire, and at the beginning of the various sections, where relevant.

The questionnaire was comprised of a combination of closed- and open-ended questions and was divided into various sections, for example:

- Biographical details such as gender, age, years qualified, years experience in the field, private or public health practice and whether that was part time or full time, and extra qualifications
- Categories to establish facts (knowledge of protocols), attitudes and beliefs (preference of protocols, views of efficacy), and behaviour (reasons for use such as: prescribed by a referring doctor, confidence in own skill, therapist's preference and/or due to knowledge gained from a recent study or course attended).
- Whether resource constraints influenced type of protocol used, for example, patient: therapist ratios, budget and location issues such as materials available in practice, equipment available for use, current available literature and access to journal or continuous professional development meetings.

Some open ended questions were included to obtain qualitative input regarding personal/ subjective and experiential views of the therapists concerned regarding their rationale for the use of a particular protocol.

Content validity of the questionnaire was assured by having had the questionnaire critically appraised by experts in the field of research, hand therapy and flexor tendon injuries. (Occupational Therapists were consulted who had either worked in academic institutions, had done their Masters, Doctorate or were currently busy with research. Clinicians' input was sought in conjunction with those in the academic field.) This was done in order to: 1) remove any possible ambiguity and bias within the questionnaire, 2) ensure simple questions were clear and concise without being too abridged, and 3) face validity (in other words, appropriate questions for the subject matter – and correlated with rehabilitation protocols to ensure content validity).

The questionnaire was piloted on three OT's practising in the field of hand therapy, currently studying for their Masters in Hand Rehabilitation, in order to ascertain any problems

related to questionnaire content and completion. No errors, misunderstandings or ambiguity were reported at the time.

3. 4. Procedure

The procedure consisted of:

a. Obtaining ethical clearance through the various UKZN ethics committees.
b. Thereafter, the implementation of an electronic survey (questionnaire) to target Occupational Therapists who fulfil the criteria of the sample was commenced. This entailed:
    - Contact being made with OTASA and SASHT to request permission to use their email databases of Occupational therapists who fulfil criteria to be included in the sample. A letter was emailed to them (appendix B).
    - The questionnaire (Appendix A), introductory letter (Appendix C) and letter of consent (Appendix E) were emailed to all on the databases.
    - A letter to the government hospital department heads (Appendix D) was sent out to obtain their authority and increase response rate amongst this group.
    - It was a self administered questionnaire.
c. The demographic questions in the questionnaire regarding number of years of part time / full time experience were incorporated to assist the researcher excluding those who do not fulfil the requirements of the sample.
d. Emails were sent out to all the University Head's of Department in South Africa, to obtain cooperation to assist with an increased response rate.

3. 5. Data Analysis

Descriptive statistics were obtained with data that could be categorised. Associations between categories were made to identify frequencies and trends

Non-parametrical testing, for example chi squared tests, was used to analyse discrete data. Fisher's Exact Test was used, as the sample was smaller than what was required for a Pearson Chi-square test. This information has been presented below, in comparison graphs so as to differentiate between various protocols used and between various levels of experience of the therapists using them, and other information. Percentages and ratios were obtained for the

groups of therapists with more or less working experience, and which protocols they preferred. Frequencies of various protocols used, comparisons between protocols, indicating popularity, and the motivations for the use of the various protocols were obtained. Comparisons between the two sample groups, n1 (private) and n2 (public) were done, and in some cases, for those that worked in both settings.

The data analysis software programme, Statistical Package for the Social Sciences (SPSS, version 19) was used, especially for doing frequency correlations, and comparisons of private practice therapists versus provincial Occupational Therapist responses. Two statisticians were consulted to further advise on data analysis and assist with interpretation of results, as the researcher had minimal prior knowledge and no prior experience of statistical analysis. Only one table (Table 2) was used in its original format, as produced by the programme, SPSS, with the assistance of one of the statisticians. It was discussed with the statistician and used in this dissertation as a concise illustration of results. All other graphs were created in Excel by the researcher, without any external assistance.

The researcher was aware of acquiescent response set, missing data, and central tendency bias, thus some options for responses in the questionnaire were between 4 variables (Always, Most of the time, Some of the time and Never).

3. 6. Ethical considerations

Ethical consent was obtained from the Ethics Committee of the School of Health Science Research Ethics and Higher Education Committee of the University of KwaZulu-Natal (number HSS/0017/2011 M). This was highlighted to the participants in the covering letter included with the questionnaires sent out. OTASA did not give the researcher access to the database, but for a fee of R850, sent the questionnaire, with attached letters, by email. The researcher was not privy to the names of those who received the email. SASHT gave the researcher the list of all members on their database, at no charge. The names of physiotherapists were excluded manually, and the researcher emailed the questionnaire with attached letters to the participants. As electronic media was used, consent was assumed by response, although many additionally sent their consent forms back electronically. This was, however, stated in the covering letter and in the consent form. Electronic information would be encrypted to ensure further confidentiality. Completed questionnaires received by fax or

post, have been stored in an unmarked file in a sealed box, which has been kept in a storeroom with a hidden door, under lock and key. The electronic responses have been kept in a sub folder with secured access, on a laptop requiring a password, not used regularly by the researcher, in a safe, secure location. (The researcher used a notebook for the Masters work, but used either an iPad or a Macbook for everyday computer work.)

The following was taken into account:

- The introductory letter stated the expectations of the participants and steps taken to ensure anonymity and confidentiality.
- Letters to Department Heads of institutions requesting their cooperation to carry out the research with their Occupational Therapy staff were compiled and accompanied by information sheets.

Chapter 4

This chapter will describe the findings of the study, as gathered from the questionnaire.

Results

Thirty two (32) Occupational Therapists in total responded to the questionnaire. At the time of the survey, which was sent out to OTASA and SASHT, OTASA had 1780 members, of which 182 members had informed OTASA that they treated hand injuries and made splints, and SASHT had 139 members, of which 9 were physiotherapists, and thus excluded from the study sample. Unfortunately, the questionnaire did not ask the respondents of which societies they were members. Therefore, if one assumes they were all from OTASA, the percentage response rate was 17.6% (32 of 182) or if they were all from SASHT, the percentage response rate was 24.6% (32 of 130). However, if they were from either OTASA or SASHT, the response rate was 10.3% (32 of 312). Unfortunately, the researcher was not able to establish how many of the respondents were members of both societies as neither OTASA nor SASHT had a record of this. This could mean the percentage response rate may have been somewhere in between 10.3% and 24.6%.

Section A of the questionnaire covered demographic information. All of the respondents were female and the majority were in the 26 to 30 age group (see Figure 1 below). Their ages ranged as follows: 9.4% (3) were in the 21-25 age group, 31.3% (10) fell in the 26-30 age group, 12.5% (4) in the 31-35 age group, 18.8% (6) were between 36 and 40 years old, 15.6% (5) were between 41 and 45, and 12.5% (4) were 46 or older.

Figure 1: Age of the participants

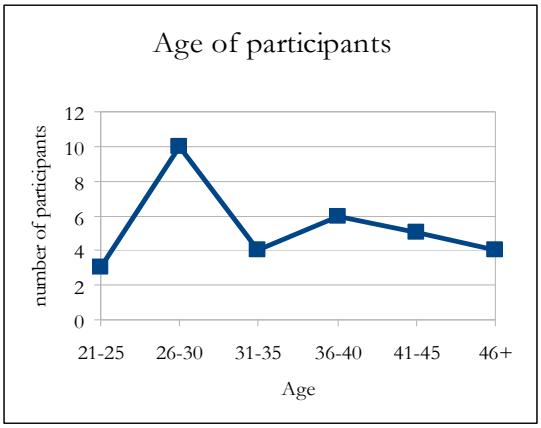
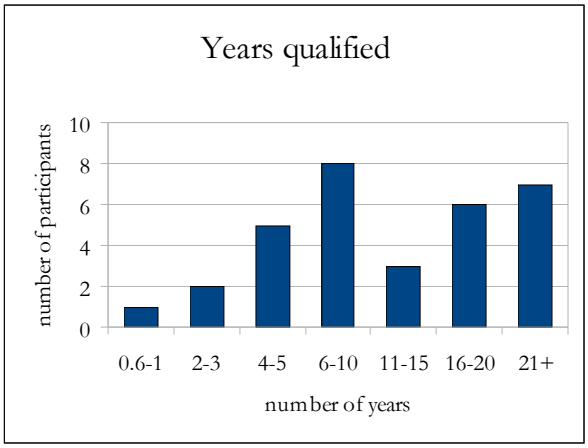


Figure 2 below, shows the number of years the respondents were qualified. The largest group of respondents (25% or 8 participants) had been qualified for between 6 and 10 years, followed by those qualified for 21 or more years (21.9% or 7 participants). 18.8% (6) had been qualified for 16-20 years, and 15.6% (5) had been qualified for 4-5 years. Of the remaining groups of respondents, 9.4% (3) had been qualified for 11-15 years, 6.3% (2) had been qualified for 2-3 years and 3.1% (1) for 6 months to a year. No one had been qualified for less than 6 months, which would have excluded them from the study sample. During the analysis, the therapists were divided up into junior (5 years or less – 25%), intermediate (6-15 years experience – 34, 4%) and senior (16 years or more experience – 40.6%) in some circumstances, but due to the small sample size, it was necessary to divide the group into junior (10 years or less experience – 50%) and senior (more than 11 years experience – 50%) in other circumstances, to obtain relevant data for certain comparisons.

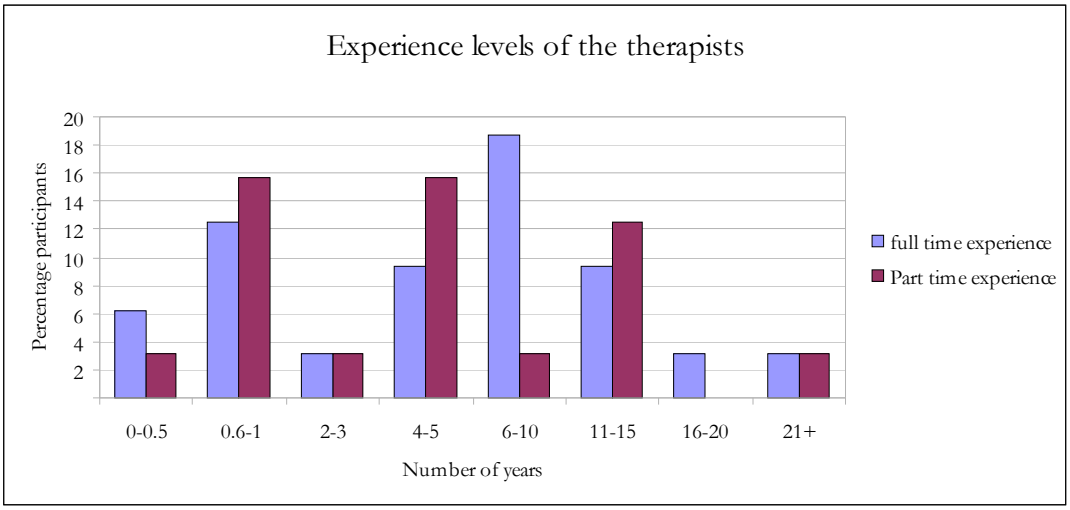
Figure 2: Number of years the respondents were qualified



Regarding years experience in the field of hand therapy, both part time, full time, and time allocated to the treatment of clients per week, some respondents had worked full time and were now only working part time, or vice versa, hence the number of hours allocated per week, was asked. Of those with part time experience, 27.8% (5) had worked 6 months to a year, and 27.8% (5) had worked 4-5 years. 22.2% (4) had worked 11-15 years part time. Only one respondent (5.6%) from each category of; less than 6 months, 2-3 years, 6-10 years or more than 21 years, had worked part time. Regarding those respondents with full time experience in the field of hand therapy, 28.6% (6) had worked 6-10 years and 19% (4) had worked between 6 months and a year. In the categories of 4-5 years and 11-15 years full time experience, 14.3% (3) of respondents fell into each category. 9.5% (2) had worked less than 6

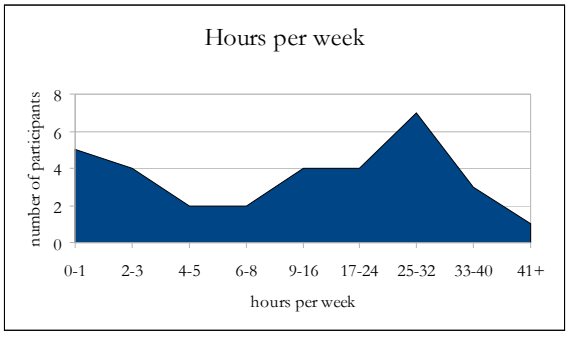
months full time and the rest (1 each) had worked 2-3 years, 16-20 or more than 21 years full time (4.8%). See Figure 3 below.

Figure 3: Number of years experience in field of hand therapy



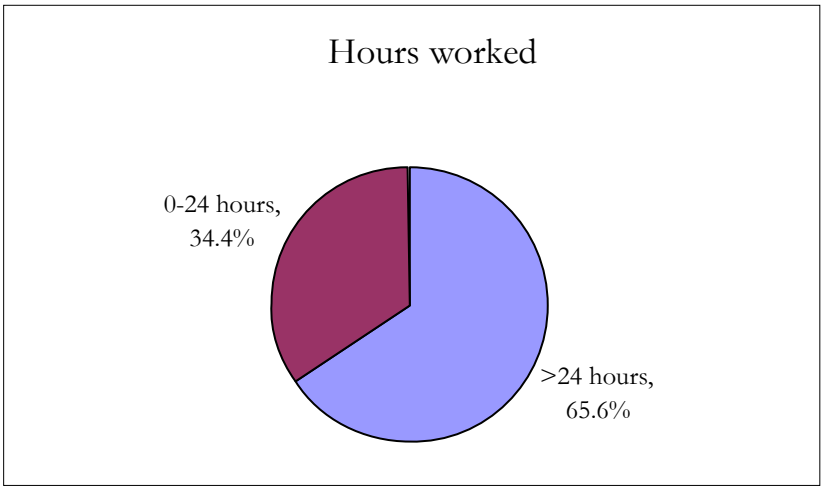
Full time work has usually been defined as 40 hours per week in South Africa, but in this context, few of the respondents worked 33 hours or more per week. Only 12.5% of respondents were actually currently working full time. The majority i.e. (11) 34.4% were doing a morning (or part thereof) or a short clinic once a week. 15.6% (5) were doing 0-1 hours a week, 12.5% (4) were doing 2-3 hours a week and 6.3% (2) were doing 4-5 hours. Of those that worked 0-1 hour per week, one commented that she was on extended sick leave at the time, and another was about to start her own practice. Only 6.3% (2) did a full day of hand therapy or 6-8 hours spread over the week. 21.9% (7) of respondents worked 25-32 hours a week and in the categories 17-24 hours and 9-16 hours a week, 4 respondents worked in each category (12.5%). In other words, just less than half of the respondents (46.9%) worked between 9 and 32 hours a week in hand therapy. See Figure 4 below.

Figure 4: Hours of hand therapy practiced per week



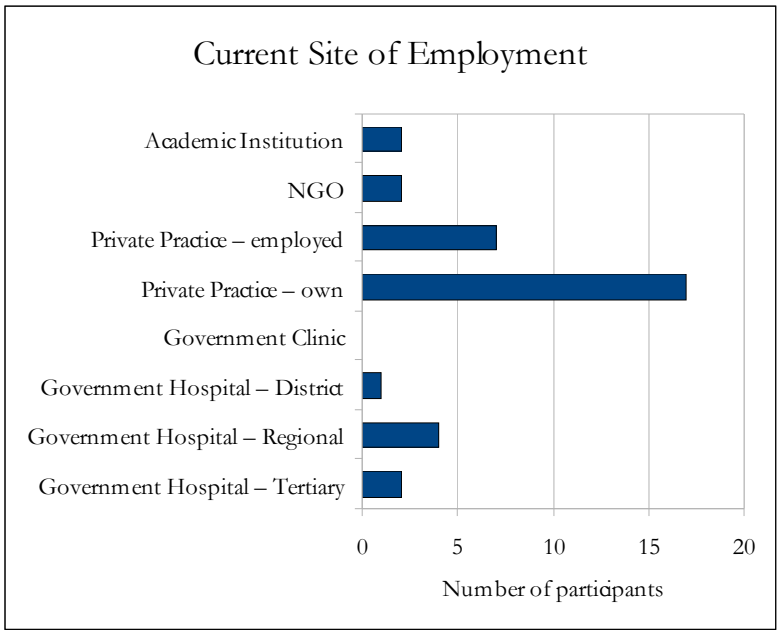
Therefore, for comparing therapists that were working more than just mornings or part thereof, in hand therapy against those working longer hours, it was decided to divide the group into those working up to 24 hours per week (almost 5 hours a morning or 3 full days – 34.4%) and those who worked more than 24 hours per week (65.6%). See Figure 5 below.

Figure 5: Hours worked in hand rehabilitation per week - summarized



Of the 32 respondents, 28% (9) worked in the government sector; 6.2% (2) at a tertiary hospital, 12.5% (4) at a regional hospital and the least i.e. 3.1% (1) worked at a district hospital. 6.3% (2) worked at an academic institution. None worked at a clinic. See Figure 6 below.

Figure 6: Current site of Employment



The majority i.e. 81.2% (26) worked in Private Practice – either their own (53.1% - 17), or employed in a private practice (21.9% - 7) or employed by a Non-governmental Organisation (6.2% - 2 participants).

Some participants worked in more than one location (two worked in both government and private sectors), hence the percentages adding up to more than 100%.

With regards to those respondents who had additional qualifications, (Figure 7 on the following page) 28.1% (9) had obtained a Diploma in Hand Therapy, but none had yet obtained a Masters or Doctorate in Hand Therapy. One respondent noted that she had begun a Diploma in Hand Therapy but had discontinued it due to family needs, and one was currently busy with her diploma in hand therapy. One respondent was currently busy with her Masters in Hand Therapy.

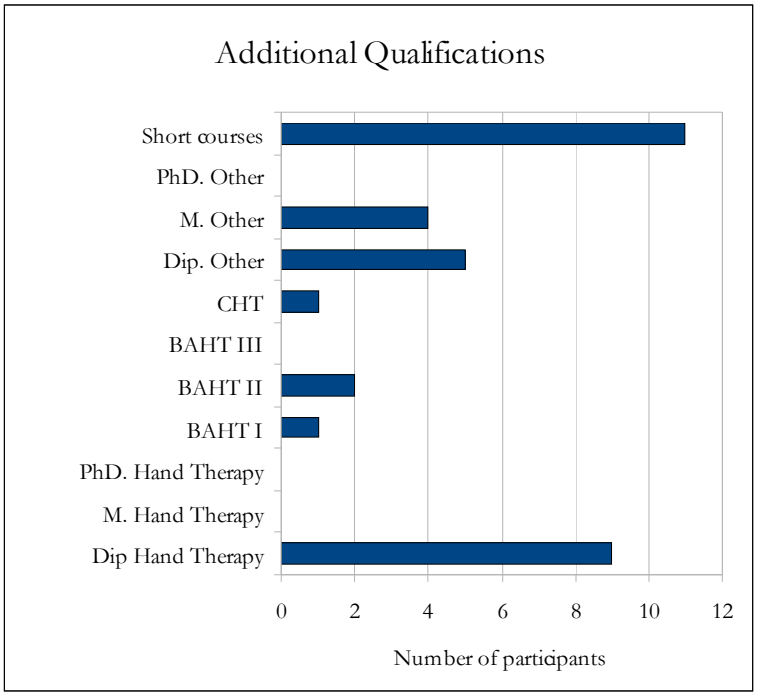
The British Association of Hand Therapy (BAHT) had developed reputable courses for therapists that wish to train further in the field of hand therapy. 3.1% (1) of respondents had completed level I, 6.2% (2) had completed level II, but none had yet completed the final stage, level III.

The Hand Therapy Certification Commission of America had developed a standardised evaluation method to certify hand therapists – and amongst the respondents, one (3.1%) was a Certified Hand Therapist (CHT). Another respondent had done a fellowship in the United States of America in hand therapy.

Regarding other post graduate qualifications, 15.6% (5) had completed diplomas in the various fields (6.2% (2) in Vocational Rehabilitation, 3.1% (1) in advanced Occupational Therapy (neuroscience) and 3.1% (1) in Paramedics. Four respondents or 12.5% of the sample had completed their Masters in various fields (3.1% (1) in Neurosciences, 6.2% (2) in Occupational Therapy and 3.1% (1) in Public Health). One respondent was currently busy with a Masters in OT. None had yet completed their Doctorate, although one had just submitted her dissertation for a Doctorate in OT.

34.4% (11) stated they had done various other short courses such as Neurodevelopmental Techniques (6.2% or 2 respondents). One respondent named courses she had attended, namely, The Hand and Plastic Brain, by Brigitta Rosen, Hand Therapy Basics, by Corrianne van Velze, and Hand Modalities, coordinated by SASHT. Another named topics she had covered in courses, namely "nerve, tendon, septic injuries, etc" (sic). A total of 62.5% specified short courses they had attended, although some simply stated "various" or "numerous". "Short courses" as a subdivision of this question, was included to provide leeway for respondents who had done additional qualifications not listed, such as modality training, Neurodevelopmental Technique or Sensory Integration, which may not have been categorized under "Other". Some respondents, however, appeared to indicate Continuing Professional Development activities.

Figure 7: Additional qualifications of respondents



In **Section B**, the second section of the questionnaire, occupational specific questions were asked to obtain information about specifics of the rehabilitation protocols therapists were using to treat flexor tendon injuries.

Two therapists (6.2%) did not specifically splint the patients who had sustained flexor tendon injuries post operatively, as the protocol of the institution where they worked was that the doctor would place the patient in a dorsal Plaster of Paris cast, with Kleinert pulleys to the

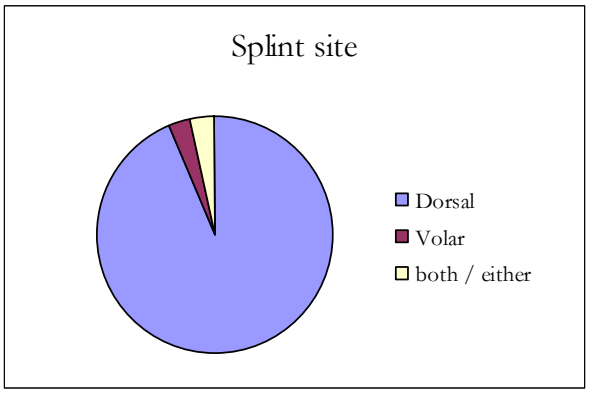
fingers, for 4 weeks, and only thereafter, if splinting was required, the OT would splint the patient. The Fisher's Exact test scored a value of p=0.077 with regards to a sector analysis of whether the therapist splinted or not was applied and showed no statistically significant differences between methods used in the state sector and those used in the private sector. The two therapists that did not splint, worked in the public sector – ie. 28.6% of the respondents, who work in the public sector.

The Fisher's Exact test scored a value of p=1.0, which demonstrated no statistically significant difference between those who splint or do not splint post operatively, with regards to levels of experience. In terms of experience, one therapist who did not splint, had substantial experience (over 16 years of experience – 8.3% of the group of more experienced therapists) and one had intermediate experience (between 6 and 15 years of experience – 9.1% of the group of respondents with 6-15 years of experience).

One respondent did not complete any further fields other than section A.

Regarding the question on where the therapist splinted the patient, the majority i.e. 93.5% (29) splinted the patient dorsally, one (3.2%) splinted on the volar aspect and the remaining 3.2% (1) splinted both or either (she marked both options – volar and dorsal). See Figure 8 below.

Figure 8: Splint site



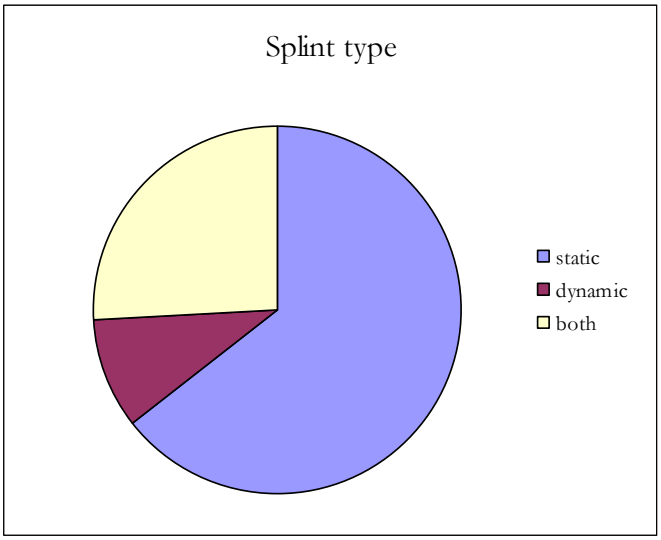
In the sector analysis, 7 of the 31 (22.6%) were working in the public health system, all of which splinted dorsally – 23.3% of the group that splinted dorsally. Two worked in both public and private health systems, and both of them splinted dorsally, i.e. 6.7%. 70% of the respondents; those in the private sector, splinted dorsally (95.5% of the private health care group), and only 1 respondent, who incidentally worked in the private sector, splinted either

dorsally or volarly, or both, (4.5%). The Fisher's Exact test demonstrated no statistically significant difference (p=1.0) for the sector analysis.

Regarding levels of experience, the only therapist that splinted either dorsally or volarly, or both, was in the most experienced category of 16 years experience and more. She made up 3.2% of the respondents and 8.3% of the group that had 16 or more years experience. The rest splinted dorsally; 26.7% (8) from the group with less than 6 years experience, 36.7% (11) from those that had between 6 and 15 years experience and the same amount, 36.7% (11), from the group with 16 or more years experience. When comparing splint site by therapists with various levels of experience, no statistically significant difference was found (p=1.0 in the Fisher's Exact test).

The majority i.e. 64.5% (20) of respondents made use of static splints, whether in private or public sectors, or both, whereas only 9.7% (3) used dynamic splints and 25.8% (8) used a combination of both, static and dynamic splints during the course of their rehabilitation process. See Figure 9 below.

Figure 9: Types of splints most commonly applied/used



In the sector analysis, the therapists in the private sector tended to mainly make use of static splints (68.2% or 15 – which comprised of 75% on the total of those who made static splints.) One therapist in the private sector only made dynamic splints, ie. 4.5% of the private therapist group and 33.3% of the total group of respondents. Six (6) therapists in private practice (27.3%) made use of both types of splints, in other words 75% of the total number of

respondents. In the public sector, 57.1% (4) Occupational Therapists used static splints (20% of all those who used static splints), 28.6% (2) of the government therapists used dynamic splints (66.7% of all those who used dynamic splints) and 14.3% (1) used both. Two therapists worked in both private and public sectors and one used static splints, in other words, 5% of the total group using static splints, and the other (1) used a combination of both types, in other words, 12.5% of the total group that used both static and dynamic splints. Fisher's Exact Test was p=0.395, which demonstrated no statistically significant difference between the type of splint used and where the therapist worked. However, private practitioners in this study, tended to be the more inclined, of the two sectors, to make use of dynamic splinting (in conjunction with static splinting), even though this was not statistically significant. Was this due to resources and time available, financial benefit from billing or other factors? Unfortunately the instrument did not address the reasoning behind this.

When comparing those with more and less experience, please refer to Table 2 below.

Table 2: Experience analysis of splint type used.

			Splint type			
			static	dynamic	both	Total
Experience	less than 6	Count	7	0	1	8
		% within experience	87.5%	.0%	12.5%	100.0%
		% within Splint type	35.0%	.0%	12.5%	25.8%
	from 6 and 15	Count	7	2	2	11
		% within experience	63.6%	18.2%	18.2%	100.0%
		% within Splint type	35.0%	66.7%	25.0%	35.5%
	from 16 upwards	Count	6	1	5	12
		% within experience	50.0%	8.3%	41.7%	100.0%
		% within Splint type	30.0%	33.3%	62.5%	38.7%
Total		Count	20	3	8	31
		% within experience	64.5%	9.7%	25.8%	100.0%
		% within Splint type	100.0%	100.0%	100.0%	100.0%

25.8% of the respondents fell into the category of less than 6 years experience, of which the majority, 87.5% (7) splinted statically. One therapist said she splinted statically and dynamically (12.5%). 35.5% of the respondents had between 6 and 15 years experience, and of these 63.6% (7) splinted statically, 18.2% (2) splinted dynamically and 18.2% (2) splinted both types of splints. In the group that had 16 or more years experience (38.7%), a smaller percentage than

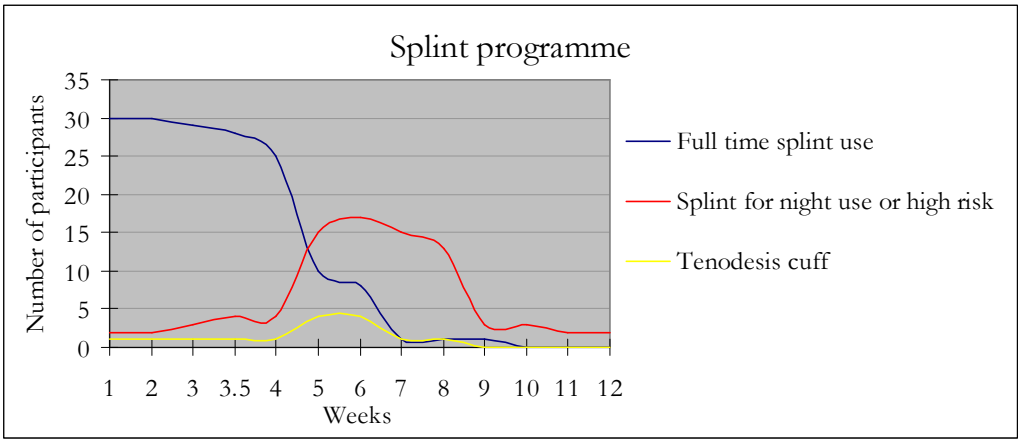
that of the less experienced groups splinted statically, ie. 50% (6), making up 30% of the total number of therapists that splinted statically. One experienced therapist (8.3%) made use of dynamic splints only and 41.7% (5) used both. This latter group made up 62.5% of the total number of respondents who made use of both static and dynamic splints. However, no statistical significant difference was found between the experience levels of the therapists and which splint they preferred to use, as Fisher's Exact test scored p=0.418. Although, this finding was not statistically significant, it was interesting to note, as the Kleinert regime – a dynamic splinting regime, was a new development in the 1960's and 1970's, and may have been preferred by the older generation of therapists and doctors alike. See Table 2 on the previous page for reference.

The experience analysis showed that the older or more experienced therapists tended to be certain of the name of the protocol they used. 83.3% (10) of the therapists with 16 or more years experience, gave their protocols a valid name. Similarly, 73.7% (8) of the therapists with 6-15 years experience gave their protocols a name and 62.5% (5) of those with less than 6 years experience named the protocols they were using. 18.2% (2) were unsure of whether the protocol had a name in the group of therapists with 6-15 years experience and 25% (2) responded likewise in the group with less than 6 years experience. A total of 4 (12.9%) of the respondents said the protocols they were using, did not have names. Half (2) of these respondents were from the most experienced group, 25% (1) was from the least experienced group and 25% (1) came from the 6-15 years experience category. These 4 therapists that were unsure of the name of the protocol all worked in the private sector, as the sector analysis showed. Of the 4 that said their protocols did not have a name, 3 worked in the private sector (13.6% of the private sector) and one worked in the public sector (14.3% of the public sector).

A traditional splinting programme, as discussed in detail in the literature review, tended to vary between therapists but general principles were that the tendon repair took 12 weeks to heal completely, and thus should be protected for about half that time, in a protective splint.

Figure 10 on the following page, shows a summary of what the respondents answered with regards to the splint programme they most commonly used. In other words, how long they used the splint full time, and when they begin to wean the splint, only using it for night use or high risk use. Figure 10 indicates as to whether or not a tenodesis cuff (a modification of the Kleinert regimen) was used at all and, if so, when.

Figure 10: Splint programme



As one can see from the graph above, most therapists were still using a splint full time at 4 weeks (i.e. 25 participants, 83.3% of those that answered this question). 33.3% (10) were still using the splint at 5 weeks and 26.6% (8) were still using the splint at 6 weeks. Thereafter, only one respondent continued using the splint full time, until 9 weeks. No one was still using a splint full time from 10 weeks. When comparing full time use of the splint at 3.5 weeks with the OT's with more or less experience, no statistically significant difference was found (the Odds Ratio was 0.867 – CI95%: 0.049 – 15.279, p=1.0). Even though there were no statistically significant differences, it did show that the more experienced therapists were less likely to use the splint full time at 3.5 weeks.

Regarding the use of the splint for a protective measure at night or during high risk activities, referring to Figure 10 above, 50% (15) used the splint from week 5, 56.7% (17) used it during week 6, 50% (15) used it in week 7, and 43.3% (13) used it during week 8. Prior to week 5 and after week 8, a minority used the splint for night or high risk use. Only 6.7% (2) were still using the splint in week 11 and 12, and the same amount were using it for night and high risk use from week 1-2. Regarding the use of the tenodesis cuff, only 13.3% (4) used it as it had been traditionally described – during week 5 and 6 (although protocols that used it from as early as 3.5 weeks do exist).

Some therapists added additional comments regarding their splinting regime. One therapist commented that if Zone II and III repairs resulted in flexion contractures, she would consider serial extension splinting at week 7-8. She normally would splint the client with a static dorsal splint for 6 weeks and then wean for a further 2-3 weeks, making use of an EAM regime with

combined controlled movements. Another therapist said that although her patients would wear the splint for a full 6 weeks, they removed the splint for exercises only, from 4 weeks. She used protective splinting from week 7-8 and used an adapted Duran protocol. The Duran and Houser protocol was likewise used by a therapist whose patients wore the dorsal static splint for 4 weeks and the tenodesis cuff from week 5-8, began graded resistance from 7.5 - 8 weeks. She did not use the Kleinert regime of dynamic splinting or traction into flexion, even though she used the tenodesis cuff. Some textbooks (Stanley and Tribuzi, 1992, Hunter et al, 2002) have described the Duran protocol in this way.

One of the therapists who made use of the Immobilization protocol, splinted for 3 weeks and then changed to a protective splint at night and high risk until week 7. She commented that she would convert the splint to a volar resting splint at week 6-7 (she remarked that she used both the volar and the dorsal splints), if flexor shortening had occurred, for night use only, but discontinue this at week 7. Another therapist who said she used a combination of the Duran protocol and the Early Active Mobilization protocol, allowed her patients to only remove the dorsal static splint for hand washing at week 5, but they were to maintain the wrist and hand position, and then the splint was weaned from week 6 for 4 weeks (until week 10). This was almost identical to what was recommended by Mennen and Van Velze (2008). Two therapists said that the doctor placed the patient in a POP slab (one specified it was a POP splint with Kleinert traction bands), either for 4 weeks or for 2 weeks, using a Kleinert protocol, in combination with an EAM protocol making use of "place and hold" exercises.

In the experience analysis, the choice of splinting protocol did not show any statistically significant differences between those that had more than 10 years experience or those with 10 years or less experience, whether it be full time splint use, high risk or night use of the splint or the use of the tenodesis cuff.

The questionnaire asked the respondents to write out in which position they made the splint for various periods of time. From 0-3 weeks, the mean position of the wrist was 17.2° of flexion, with a standard deviation of 14.5° (the median was 20°), of the knuckles (MCPj's) was 68.3° of flexion, with a standard deviation of 16.2° (the median was 70°), and of the fingers (IPj's) was 2° flexion with a standard deviation of 8.6° (the range was 0° to 45°, with a median of 0°). From 3-6 weeks, the mean position of the wrist was 13.2° of flexion, with a standard deviation of 14° (a median of 10°), and the mean position of the knuckles (MCPj's) was 68.8°

of flexion, with a standard deviation of 17.7° (a median of 70°), and of the fingers (IPj's) was 0° or neutral.

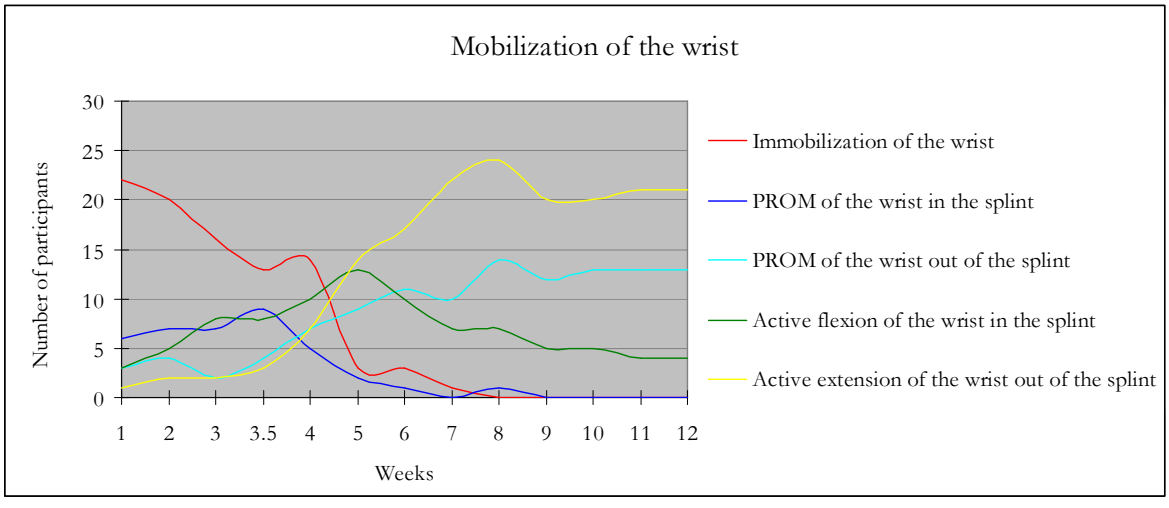
Although the splint was often discontinued from 6 weeks, some of the respondents (28% or 9) indicated in what position they would keep the wrist, being at a mean of 0.3°, with a range of -15° or slight extension of the wrist, to 10° flexion (a median of 0° or neutral), the MCPj's at a mean of 43.6° (standard deviation of 33°, and a median of 50°) and the IPj's at 0° or full extension.

Regarding mobilization of the wrist and fingers, protocols vary tremendously as do preferences amongst surgeons and therapists. The respondents provided valuable information which has been summarized in Figure 11 below, and Figure 12 on the following page.

The respondents tended to immobilize the wrist for longer than they did for the fingers, and tended to focus more on the mobilization of the fingers than they did on the wrist.

Regarding the wrist mobilizations, no one immobilized the wrist beyond 7 weeks, with the majority only immobilizing the wrist for 3 weeks; 73.3% (22) in week 1, 66.7% (20) in week 2 and 53.3% (16) in week 3. Fourteen or 46.7% immobilized the wrist during week 4 and only 10% (3) continued to immobilize the wrist in week 5 and 6. Only 1 respondent (3.3%) immobilized the wrist in week 7 and no one immobilized the wrist from week 8 and beyond (see the red line in Figure 11 below).

Figure 11: Mobilization of the wrist



Passive range of motion in the splint – ie passive flexion and protected passive extension of the wrist, can be tricky to perform, as the splint could intrude on the action. But 20% (6) began this at week 1, 23.3% (7) continued this from week 2-3. Nine or 30% reported doing this passive range of motion in the splint at week 3.5. Only 16.7% (5) were doing this at week 4, 6.7% (2) at week 5 and 3.3% (1) at week 6 and week 8 (see the dark blue line in Figure 11 on the previous page).

Passive range of motion of the wrist out of the splint was preferred from week 5 (30% or 9 respondents), and the figures gradually increase to a peak at week 8 (46.7% or 14 respondents) and then plateau towards to end of the traditional 12 week period at 43.3% (13) of the sample doing passive range of motion in week 10, 11 and 12. Only a few begin this motion from week 1 (10% or 3 participants). See the light blue line on Figure 11 on the previous page.

Active flexion of the wrist in the splint (a protected position) peaked at week 5 where 43.3% (13) of the sample were doing this action, with 33.3% (10) doing it on either side of week 5, namely week 4 and week 6. Interestingly, 13.3% (4) of the sample were still doing this at week 11 and 12. (See the dark green line in Figure 11 on the previous page).

With regard to active extension of the wrist out of the splint, which was an action to be done with care, most of the sample (i.e. 56.7% or 17 respondents) began this from week 6 – the stage when tendon healing has been progressing well. Twenty two or 73.3% did active extension of the wrist out of the splint during week 7 and 80% (24) did it at week 8. Twenty or 66.7% continued this at week 9 and 10 and 70% (21) continued until week 11 and 12. Only 1 therapist (3.3%) was brave enough to do active extension of the wrist out of the splint from week 1, and 6.7% (2) did this during week 2 and 3 and so the numbers gradually grew. (See the yellow line in Figure 11 on the previous page).

This particular therapist said that full flexion and extension to 10˚ at wrist from week 1 was allowed– but she was unsure of the name of this protocol. Another therapist limited wrist extension to 30˚ at week 2, out of splint with the fingers flexed (similar to tenodesis). She was making use of the EAM protocol. Some comments made by the respondents indicated that PROM of wrist in splint was always supervised by the therapist. Another therapist said she allowed PROM of the wrist out of the splint from week 3.5 and active flexion of the wrist from week 5 in the splint only during therapy sessions. She said this protocol was not named

but had said earlier that she used a Kleinert type splint, making use of both dynamic and static splints. One therapist, who used EAM, said she used the tenodesis action of the wrist from 8 weeks but did not allow composite wrist and finger extension until 12 weeks. She said she used this in conjunction with splinting out contractures.

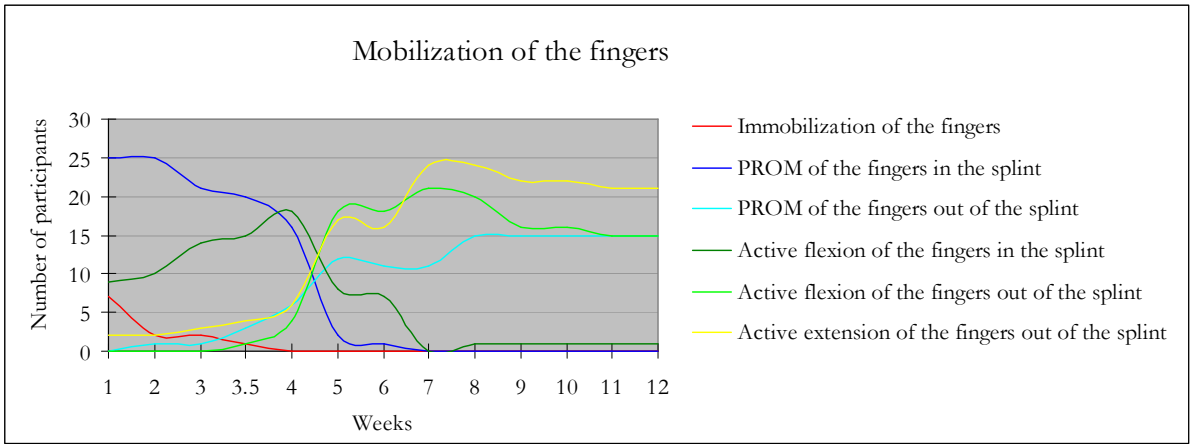
In the experience analysis, no statistically significant difference between therapists with more than 10 years experience or those with 10 years or less experience, was found in terms of their choice of mobilization protocol of the wrist, whether it be immobilization of the wrist, passive range of motion of the wrist, whether it was in the splint or out of it, active flexion of the wrist in the splint or active extension of the wrist out of the splint.

Regarding mobilization of the fingers, Figure 12 on the following page, provides a good summary of the actions of the respondents in the sample.

Only 23.3% (7 participants) immobilized the fingers from week 1, with no one immobilizing the fingers beyond week 3.5, and only 6.7% of the respondents were still immobilizing the fingers at week 2 and 3. Of these respondents, 50% (1) worked in the state sector and the 50% (the other) worked in private practice. (See the red line in Figure 12 on the following page.)

It was the OT working in the private sector that continued immobilization until week 3.5. There was no statistically significant difference between those that did and did not immobilize at this stage, whether in private or state sectors ($p=0.469$ in the Fisher's Exact Test). Prior to this, in week 1, 57.1% (4) of the therapists who immobilized were working in the private sector (only 18.2% of those who worked privately) and 42.9% (3) worked in the government sector, but this was only 37.5% of the total that worked in the government sector. In other words, a minority favoured immobilization at the early stages of rehabilitation. It was interesting to note that those who favoured immobilization tended to be those in the private sector, albeit a small percentage of the private sector group (4 private therapists as opposed to 3 state employees). One could thus not blame difficulties regarding the compliance (and thus a need for either more regular, direct therapy sessions or supervision, or a need for a protocol of immobilization) as having resulted from the patient population characteristics. The reason behind why the therapists were immobilizing was unfortunately not asked in the questionnaire.

Figure 12: Mobilization of the fingers



Passive range of motion of the fingers in the splint, was favoured by more than half of the respondents up until week 4; 83.3% (25) respondents did this in week 1 and 2, 70% (21) did this in week 3 and 53.3% (16) continued in week 4. Interestingly, only 6.7% (2) passively mobilized the fingers in the splint at week 5 and only 3.3% continued to do this at week 6 (see the dark blue line in Figure 12 above).

In terms of those who passively mobilized the fingers out of the splint at week 5, 75% (9) were from the government sector and the other quarter (3) worked in the private sector, although no statistically significant difference was found between the two sectors ($p=1.0$). There seemed to be a trend to rather passively mobilize the fingers out of the splint, although no one did this in week 1 and only 3.3% (1 respondent) did it in week 2-3. There may have been a problem of ambiguity, as this question in the questionnaire did not state as to whether this passive range of motion was into flexion (indicated in most protocols) or into extension (not indicated in the early stages of most protocols). This was an unfortunate potential bias in the questionnaire due to an unforeseen ambiguity of this question that was not noticed in the pilot, possibly as most therapists assumed one would not do extension of the fingers at this stage, but this was not stated. Having said that, 50% (15) of the sample did passive range of motion of the fingers out of the splint from week 8–12, 36.7% (11) did it during week 6 and 7, 40% (12) during week 5 and 20% (6) during week 4 (see the light blue line in Figure 12 above).

Active flexion of the fingers was divided into the action in the splint (dark green line in Figure 12 above) and the action out of the splint (the light green line in Figure 12 on the previous page). Almost two thirds (60% or 18) of the respondents were allowing active flexion of the fingers in the splint at week 4 (a percentage that had climbed gradually from week 1 of 30% (9

respondents), whereas 60% were allowing active flexion of the fingers out of the splint from week 5 onwards – a figure that climbed steadily until 9 weeks, where it dropped to 53.3% (16) until week 10, and dropped again to 50% (15) in week 11 and 12. Prior to week 5, Active flexion of the fingers out of the splint was only allowed by 13.3% (4) of the sample at week 4 and 3.3% (1) at week 3.5. Only 1 respondent (3.3%) was still doing active flexion of the fingers in the splint at week 8 – 12. At week 5, 26.6% (8) were allowing active flexion of the fingers in the splint and 23.3% (7) were allowing this action at week 6.

Active extension of the fingers out of the splint was an action proceeded with caution from week 1 and 2 (6.7% or 2 respondents), until week 4 (20% or 6 respondents), but then from week 5, more than half of the respondents (56.7% or 17 respondents) began utilising this mobilization technique. At week 7 and 8, 80% (24) allowed active extension of the fingers out of the splint, with this figure gradually declining in week 9 – 10 (73.3% or 22 respondents) and even further in week 11 – 12 to 70% (21) (see the yellow line in Figure 12 on the previous page). The question did not state what position the wrist was in during this action, and whether or not the MCPj's of the fingers were included in the active extension. In literature, full extension of the fingers (whether the wrist was included or excluded in the extension) has often been avoided before about the half way period of rehabilitation, although tenodesis action was often utilised to ensure joints remain actively mobile, and this could be full extension of the fingers, but with the wrist fully flexed, to reduce the strain on the surgical repair of the tendon. Interestingly, more than half of the respondents began this active extension at week 5 (as seen above), slightly earlier than the half way mark.

A sector analysis of the differences between government respondents and private respondents' actions at week 5, showed no statistical difference for active flexion of the fingers out of the splint ($p=0.678$), or for active extension of the fingers out of the splint ($p=0.698$). However, it appeared private therapists were more likely to actively flex the fingers (77.8% -14 participants) and actively extend the fingers (76.5% or 13) out of the splint as opposed to the government therapists (active flexion – 22.2%, and active extension – 23.5%). Within each sector, one noticed, once again, a slight trend for the therapists in private practice to rather actively mobilize (for flexion – 63.6% of therapists in private did so, and for extension – 59.1% of therapists in private did this, as opposed to those in government – 50% in both situations).

When comparing the mobilization protocol of the fingers used by OT's with different levels of experience (more than 10 years or 10 years and less), no statistically significant difference was found either, whether for immobilization, passive range of motion in or out of the splint, active flexion in or out of the splint or active extension of the fingers out of the splint.

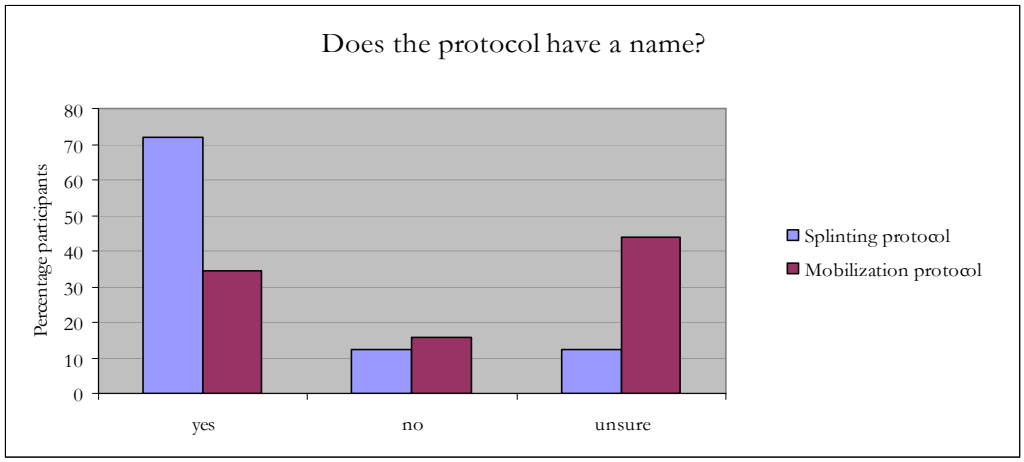
Some comments made by the respondents included two therapists, who stated they used a passive motion Duran protocol but allowed active extension of the fingers out of the splint from week 1. Of these two, one said she allowed active flexion from week 4 with tendon gliding and blocking exercises, and the other began resistance into flexion at week 8 with full resistance at week 12. Another therapist who marked "modified Duran protocol" as her choice of mobilization technique, followed the Duran (as described by Hunter et al, 2002, and Shear and Bear-Lehman, 1989), but said she would only allow exercise with resistance at week 12 as opposed to from week 10, as described. Two therapists (one used the Duran protocol and the other used the Kleinert with EAM integrated later), said they only immobilized for 2 days (one marked "week 1" for immobilization, the other did not). One therapist, who said she used the EAM protocol, specified that if the injury was in Zone II, she would immobilize the hand for week 1 and 2, but if the injury was in Zone III-V, she continued with EAM in splint. She had access to the doctor's notes, as she worked in a Regional Government Hospital, and would check these notes regarding the surgical repair tension. Her protocol included 30% range of motion at week 1, 50% range at week 2-3, 75% range at week 3.5-5, full range of motion at week 6 and at week 7, the patient would start ADLs but no resistance was yet allowed.

Another therapist using the EAM protocol, stated she used "place and hold" exercises from week 4, which Elliot et al (2005) defined as a type of EAM. Another therapist did not specify which protocol she used, but from what she wrote in the survey, it appeared she was using an EAM protocol. She specified that she made use of "assisted flexion" in the splint. General precautions were often stated by respondents, such as advising the patient to never passively stretch the fingers themselves, or to only do active flexion in the splint prior to 6 weeks.

Interestingly, as can be seen in Figure 13 on the following page, some of the respondents were using unnamed protocols (i.e. 12.5% (4) of the respondents with regards to the splinting protocol and 15.6% (5) of the respondents with regards to the mobilization protocol). Four (12.5%) were unsure of the name of the splinting protocol and 71.9% (23) claimed to know the name of the splinting protocol, namely: Duran – 3.1% (1), Modified Duran (or Modified

Duran and Houser) – 15.6% (5), Kleinert – 12.5% (4), modified Kleinert (one therapist stated she did graded mobilizations with the Kleinert and one combined the Kleinert with early active mobilization) – 12.5% (4), Early Active Mobilization or Early Active Controlled Mobilization – 28.1% (9), Immobilization – 3.1% (1), Johannesburg General Flexor Tendon Protocol – 3.1% (1).

Figure 13: Does the protocol have a name?

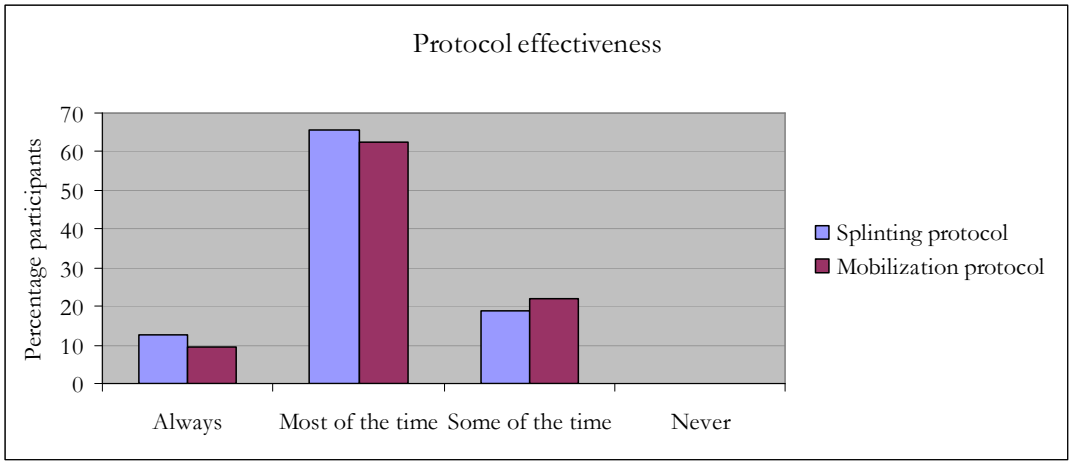


In terms of the name of the mobilization protocol, therapists were a little more uncertain, with 43.8% (14) not knowing whether the protocol had a name, and those that said the protocol had a name (34.4% or 11 participants), naming them as follows: Duran (or Duran and Houser) – 6.3% (2), Modified Duran (or Modified Duran and Houser) – 6.3% (2), Modified Kleinert (with graded mobilizations) – 3.1% (1), EAM or Early Active Controlled Mobilization – 18.8% (6), Immobilization – 3.1% (1), Johannesburg General Flexor Tendon Protocol – 3.1% (1).

Section C of the questionnaire looked at how effective the therapists thought the protocols they were using, were in producing a fully functional and aesthetic outcome, in terms of appearance and use of the hand (although this was not explicitly stated on the instrument). Figure 14 on the previous page, gives an overview. All the respondents responded positively regarding the degree of effectiveness of the protocols they were using. More than 60% felt the protocol was effective "most of the time"; with 65.6% (21) who felt the splinting protocol they were using was effective "most of the time" in producing a fully functional, aesthetic outcome and 62.5% (20) felt the same about the mobilization protocol they were using. Only 12.5% (4) felt that the splinting protocol was "always" effective and 9.4% (3) felt that the mobilization protocol was "always" effective in producing the desired outcome. 18.8% (6) marked that the

splinting protocol only produced these results "some of the time" and 21.9% (7) said likewise for the mobilization protocol.

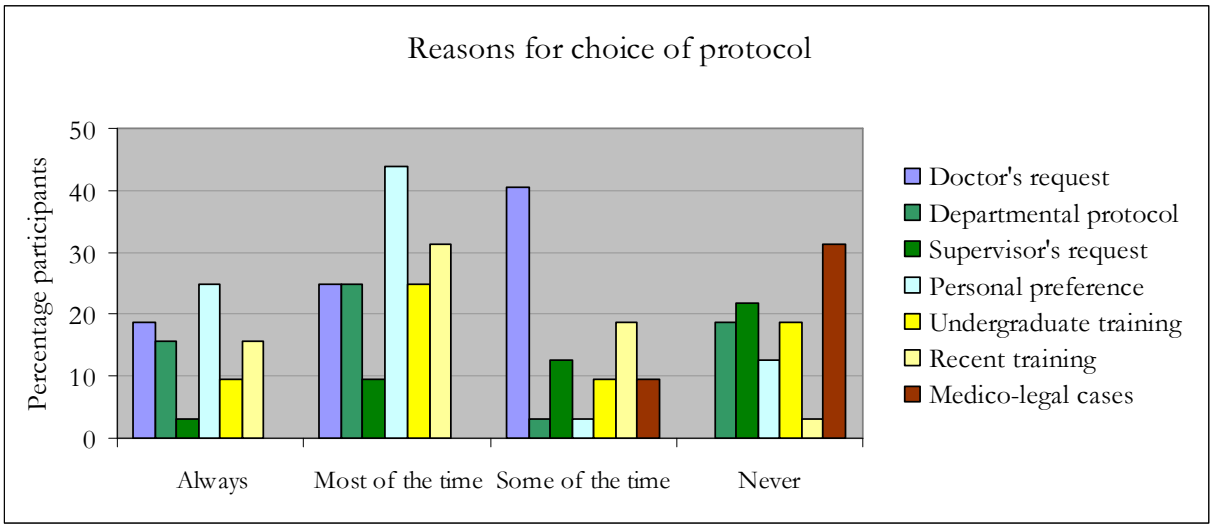
Figure 14: Protocol effectiveness



The choice of protocol was due to personal preference "most of the time" in 43.5% of the cases (14 respondents) and due to the referring doctor's request "some of the time" in 40.6% (13) of the cases. Medico-legal cases tended not to play a role with 31.3% (10) of the sample answering "never" – which was a valid percentage of 76.9%. A general overview can be seen in Figure 15 on the following page. Respondents answered "always" as a reason for the choice of protocol in the following cases, (stated in ranked order): Personal preference (25% or 8 participants), Doctor's request (18.8% or 6 participants), Departmental protocol (15.6% or 5 participants) and Recent training courses (15.6% or 5 participants). Undergraduate training (9.4% or 3 participants), and finally, Supervisor's request (3.1% or 1 participants) were of the least impact on the therapists choice of protocol. It was interesting to observe that undergraduate training did not appear to play a significant role in the therapists' choice of protocol.

Factors that did not influence the choice of protocol at all were stated as follows (in ranked order): Medico-legal cases (31.3% or 10 participants), Supervisor's request (21.9% or 7 participants), Departmental protocol (18.8% or 6 participants) and Undergraduate training (18.8% or 6 participants), Personal preference (12.5% or 4 participants), and finally, Recent training courses (3.1% or 1 participants). It was interesting to observe that recent training courses scored low with regards to "never" affecting the therapists' choice of protocol.

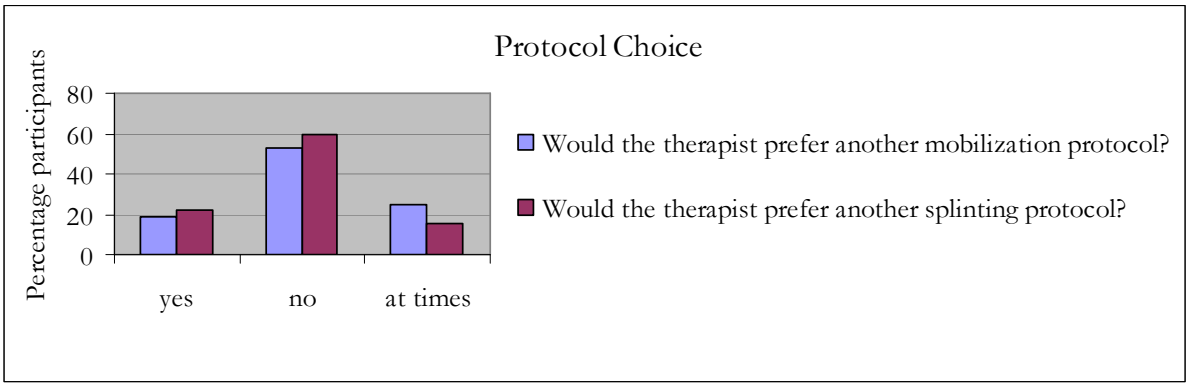
Figure 15: Reasons for the choice of protocol



The doctor's request always played a varying degree of influence in the choice of protocol, as did personal preference, undergraduate training, recent training courses and the departmental or supervisor's protocol or requests. One respondent summed it up by saying the doctor had the primary influence, then came personal preference and finally training. Another respondent made some very interesting comments that the rural working area and the need for patients to travel made immobilization the preferred protocol of both herself and the orthopaedic surgeon, both in the private and governmental sectors where she worked. She further commented that dynamic splinting (Kleinert protocols) exhaust medical aid funds more quickly so treatment regimes were not always completed due to funding. She had chosen the immobilization protocol because research she was aware of, "*lacked firm evidence that early mobilization achieves better results*". One respondent said the patient population determined her choice in protocol – ie if the patient was compliant, then EAM was used. Another said she had had problems with Kleinert.

It did surface in the questionnaires that not all therapists were happy with the protocols they currently used; 21.9% (7) said they would prefer another splinting protocol and 18.8% (6) said they would prefer another mobilization protocol. A small amount, 15.6% (5) said that "at times", they would prefer another splinting protocol and 25% (8) said that "at times", they would prefer another mobilization protocol. (See Figure 16 on the following page.) Nineteen (59.4%) were happy with their current splinting protocol and 53.1% (17) said they would not prefer another mobilization protocol. Thus, more than half of the respondents in this survey, indicated that they were satisfied with the protocols they were following

Figure 16: Protocol choice



Many therapists made additional comments such as that they were able to change the protocol according to the patient's compliance, the strength of the surgical repair, the clinical presentation of the hand. A few stated that they prefer EAM as it "*reduces adhesions*" and gave "*better results*". They said that EAM was a protocol that required good communication between the surgeon and the therapist, and the patient population was able to attend sessions and comply with the exercises. In addition, they stated that protective splinting for 6 weeks "*lowers risk of rupture*".

One therapist complained that patients were referred late as there was no hand surgeon in her area. Thus, her focus was often to reduce deformities that had occurred. Another therapist said she did not know other protocols and would like to be better informed, whereas one other said she would like training to help her "*make better decisions about which protocol to use in different situations*". One therapist said her referring doctors preferred to immobilize the hand for "*as long as possible in order for their procedure to be successful*". Another said she would consider using the immobilization protocol if the "*compliance and understanding of her patients was low, with lack of family support or guided supervision.*", which was a view reflected in literature One therapist complained that "*Kleinert doesn't work due to patient understanding, appointments and transport*", yet another one said that "*Kleinert is structured and has limited error for the therapist*". Another two therapists said they would or wanted to use it for "*tendon grafts or complex repairs, depending on likely compliance of the patient and confidence of the surgeon in the strength of the repair.*" A therapist in Zululand said that early passive mobilization (Duran protocol) was safer for her clients as they do not "*always understand the active protocol*", yet another said she would only use the Duran protocol if sufficient resources were available in terms of the clients returning and being able to pay for extra sessions.

Section D of the questionnaire covered the many possible environmental influences, as seen in Figure 17 on the following page.

Confidence in skill was the main constant influence on the choice of the protocol used, where 21.9% (7) of the sample said it "always" influenced their choice and 34.4% (11) said it influenced their choice "most of the time". Interestingly, there was no statistically significant difference in confidence in skill between therapists with more than 10 years experience and those with 10 years or less experience ($p=0.572$, with a Fisher's Exact Test/FET=2.532).

Current research trends seemed to play a role in influencing the therapists choice of protocol but, only 9.4% (3) said it "always" had an effect, whereas 34.4% (11) said it had an effect "most of the time", 37.5% (12) said it had an effect "some of the time" and 9.4% (3 participants) said it "never" had an effect. Once again, there was no statistically significant difference here ($p=1.0$, FET=0.946).

Medical aid funds did tend to play a role "some of the time", according to 40.6% (13) of the group, "most of the time" in 18.8% (6) of the cases, and "always" played a role, according to 6.3% (2) of the respondents. Seven (21.9%) said it "never" played a role. Seven was the number of respondents that solely worked in the government sector, but this should not be misinterpreted as a correlation – because, of those that said "never", 4 worked in their own private practice, 1 worked for an NGO, 1 worked in an academic institution and the last one worked in a district hospital. Of the therapists that solely worked in the government, only 2 said medical aid funds "never" affected their choice of protocol, whereas one said it sometimes affected their choice and one said it "always" did. Three respondents that worked in the government sector left this section blank. State patients were charged (or not) according to their financial status, and so if a patient was on medical aid, they would still be charged.

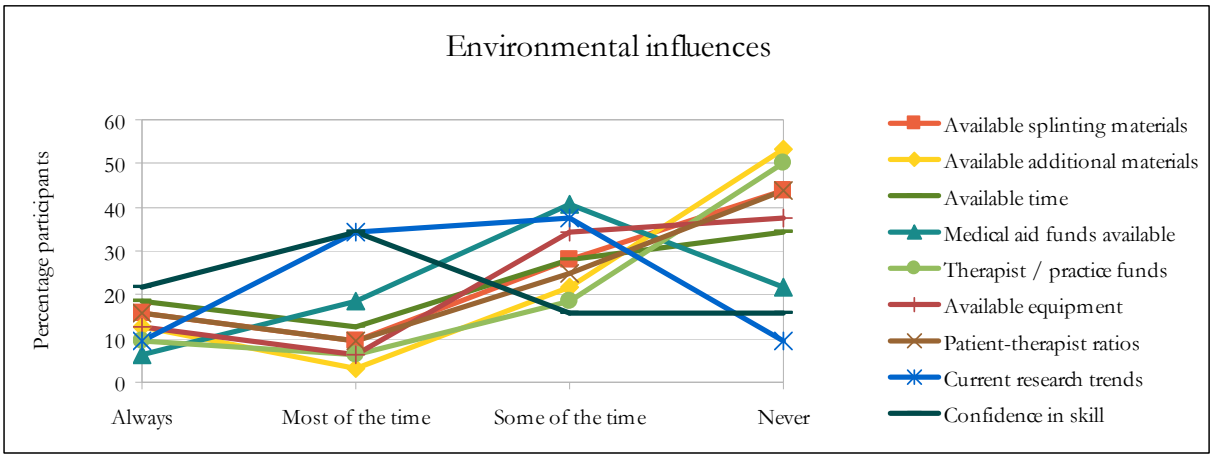
This question in Section D, as indicated in Figure 17 on the following page, additionally asked whether time available was a factor influencing the choice of protocol, which could be interpreted as time with patients and duration of sessions, or balancing time for in-patients with out-patients and administrative duties, or actual time at work. Regardless of how it was interpreted, the influence of time as opposed to other factors was required to be ranked. Time available was the second highest factor in the "always" category, with 18.8% (6) of the sample

indicating this option, 12.5% (4) marking "most of the time", 28.1% (1) indicating "some of the time" and 34.4% (11) saying that it "never" had an influence.

Available splinting materials and patient–therapist ratios followed a very similar trend, scoring "always" in 15.6% (5) of the cases, "most of the time" in 9.4% (3) of the cases and "never" in 43.8% (14) of the cases. It was only for the answer "some of the time", that available splinting materials scored higher (28.1% or 9 participants) than patient-therapist ratios (25% or 8).

A cross tabulation between private and government sectors, and patient-therapist ratios, (Always, Most, Some, Never) indicated that the private sector tended to be affected fewer times when compared with the government sector, p value=0.001 (FET=13.341). In the same cross tabulation with available splinting materials, a similar score resulted with the p value=0.0002 (FET=15.862). In other words, both of these showed statistically significant differences between the state therapists and those working in private ($p<0.005$), which is an indication that government therapists were often lacking in splinting materials and the patient load was far greater than in the private sector. This supported the literature reviewed.

Figure 17: Environmental influences



Available additional materials (such as Velcro, fishing line for dynamic splints as used in the Kleinert regime, and other materials), available equipment (such as electrical equipment and tools) and therapist / practice funds followed a similar trend, as seen in Figure 17 above, with "always" being scored by 12.5% (4) for additional materials and available equipment, but only 9.4% (4) in therapist / practice funds. These factors influenced the choice of protocol "most of the time" in 6.3% (2) of the cases for available equipment and therapist / practice funding,

and in 3.1% (1) of the sample for additional material availability. 34.4% (11) – available equipment, 21.9% (7) – available additional materials, and 18.8% (6) – therapist / practice funding, of the sample marked "some of the time" as the degree to which these factors affected the choice of protocol. Half of the sample (50% - 16) stated that therapist / practice funds "never" affected the protocol choice, while 53.1% (17) said that additional materials "never" affected their choice and 37.5% (12) said that available equipment "never" affected their protocol choice. It was interesting to find that a large percentage of the sample did not have material or financial constraints affecting their choice of protocol.

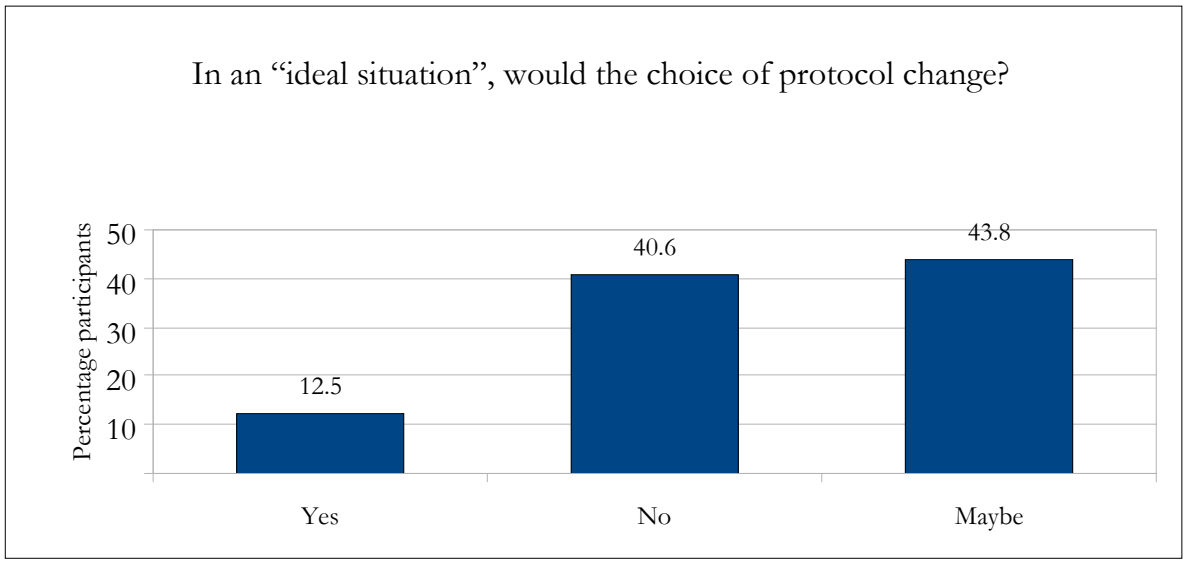
Funding has often been considered an issue influencing therapeutic intervention in the government sector, but there was no statistically significant difference between state and private therapists with regards to the therapist or the practice's funds affecting the choice of the protocol. In fact, the greater majority of both sectors said this was not a factor influencing the choice of protocol.

Four therapists commented after this question on environmental influences in Section D, which provided valuable information. One stated that the attitude of the surgeons tended to be autocratic at times, indicating a strong influence by the doctor, once again. Another said she was only familiar with the Duran protocol and needed further training, which was reflected in the "confidence in skill" section. A third said that her patient population could not attend regularly, which influenced her choice. Finally, one therapist said that she considered the patient's time and financial resources in choosing a protocol for rehabilitation.

Frustrations could develop in the working environment, when basic materials and equipment were not readily available, or funding, be it from the medical aids or from the practice or therapist, were restricted. Should it occur that the patient load was too great and time was limited, protocol choice may have been influenced and a premade splint, a POP cast, a static splint as opposed to a dynamic splint, or other "short cuts" may have been used when another method may have been preferred. The respondents were asked whether they would change their choice of protocol, if the situation was "ideal". See Figure 18 on the following page. Interestingly, 43.8% (14) said "maybe", 40.6% (13) said "no" and a smaller group, 12.5% (4) answered affirmatively. This may have indicated that therapists were open to developments in protocol usage, or perhaps the therapists were not as happy with their choice of protocol as

they thought they had been. This kind of information was not specifically extracted from the respondents, although some qualitative data was retired, as seen below.

Figure 18: In an "ideal situation", would the choice of protocol change?



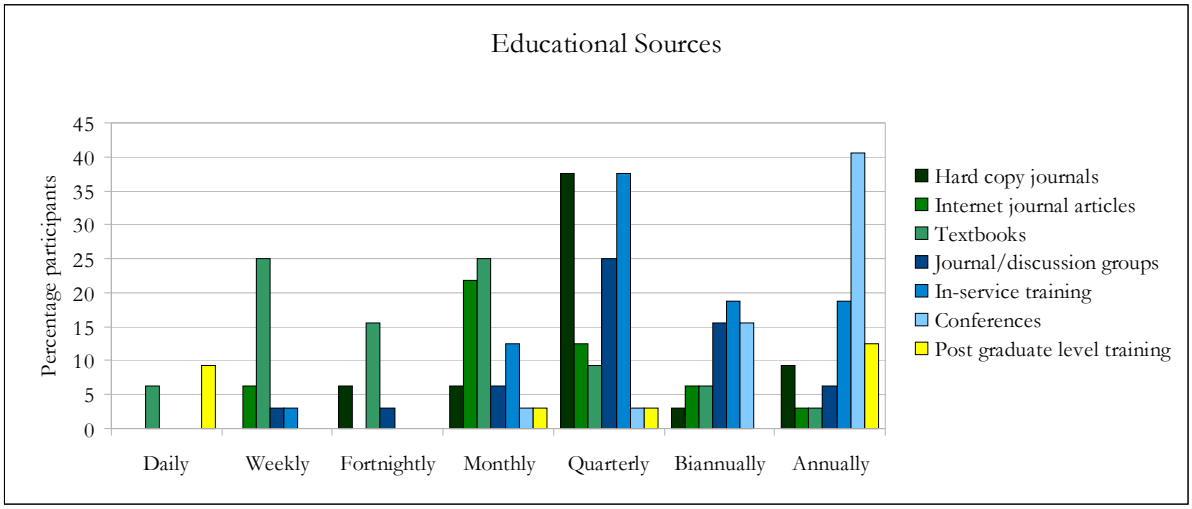
Comments after this section, included 5 therapists (15.6%) who said they would like to use the EAM or controlled active mobilization (CAM) protocol, if they:

- knew the quality of the surgery,
- had confidence in using this protocol,
- had access to research substantiating this protocol's effectiveness above others, or
- had a different population group who would comply better.

One therapist liked to vary the choice of protocol, one only wanted to use the Duran Houser protocol, another wanted to use either the Duran or the Kleinert, depending on the Zone of injury and the severity, and another wanted to use the dynamic protocol (Kleinert) in Zone II injuries – an area of injury which could result in significant scar tissue – to prevent adhesions. Finally, one therapist would like to use the Indiana protocol or the Cannon place and hold protocol, which has usually been referred to as the Strickland protocol, an "active hold" or "place and hold" mobilization protocol – a form of EAM. (Cannon was published by the Indiana Hand Centre, according to Hunter et al, 2002, thus known by some as the Indiana protocol.)

The volume and accessibility of research has been rapidly increasing with every year that goes by. With the development of technology, therapists and doctors can access current articles e.g. Wikipedia, Google and other internet-based databases, from their phones, iPad's and office internet access. Interestingly, textbooks were the only education source that was accessed daily – in 6.3% (2), although 9.4% (3) said they participated in post graduate level training on a daily basis, as Figure 19 below shows. This was questionable as how could a therapist, who may have been working in a busy practice, participate in post graduate studies daily, unless what they meant to say was that they did after hours studying or writing up on a regular basis?

Figure 19: Educational sources



Textbooks were referenced by a total of 90.6% (29) of the sample; weekly by 25% (8), fortnightly by 15.6% (5), monthly by 25% (8), quarterly by 9.4% (3), biannually by 6.3% (2), and annually by only 1 participant (3.1%), as can be seen above in the light green column in Figure 19 above.

The most regularly accessed resources, besides textbooks – on a weekly basis – were; internet journal articles (6.3% or 2 participants) and only one respondent (3.1%) for journal or discussion groups and in-service training or courses.

Internet journal articles (as seen in Figure 19 above; the mid-green column) were accessed by a total of 50% (16) of the sample, specifically; monthly by 21.9% (7), quarterly by 12.5% (4), biannually by 6.3% (2) and annually by 3.1% (1 respondent). When asked specifically which search engines or websites were accessed, not all respondents who marked "internet journal

articles" as an educational source, named the websites, but those that did, listed the following; Google (9.4% or 3 respondents), Google Scholar (3.1% - 1 respondent who additionally used Google), the University of Pretoria links for students or medical library (6.3% or 2 respondents), EBSCOHost (6.3% or 2 respondents), the British Journal of Occupational Therapy (a hard copy journal which can be accessed online by subscription) and American Journal of Hand Therapy "*passed between colleagues*" by 1 respondent (these were hard copy journals but perhaps she marked this option as they were emailed between colleagues), the British Association of Hand Therapists (BAHT), which had online journal available to BAHT members, from 2002 (3.1% or 1 respondent), CINAHL (6.3% or 2 respondents), ScienceDirect by the same 2 respondents, who additionally marked Pubmed, Medline (3.1% or 1 respondent although this was found through other searches, such as Pubmed, EBSCOHost, National Library of Medicine and others), Academic Search Premier (3.1% or 1 respondent), Elsivier Science (3.1% or 1 respondent), OTDBASE (3.1% or 1 respondent), various Occupational Therapy Associations such as the British Association and the American Association (3.1% or 1 respondent), and sadly only 3.1% or 1 respondent accessed Cochrane.

Hard copy journals (the dark green column in Figure 19 on the previous page) were accessed by 62.5% (20) of the sample, with 6.3% (2 participants) accessing them fortnightly, and monthly. Most of these respondents (37.5% or 12 participants) accessed hard copy journals quarterly, and 3.1% (1) marked biannually, and 9.4% (3) indicated they access hard copy journals annually. When asked to specify which journals, once again not every respondent that indicated they read hard copy journals, named them. The British Journal of Occupational Therapy (BJOT) was accessed by 18.8% or 6 participants, of which one indicated that this was available thought SASHT (South African Society of Hand Therapists). The "*American Hand Therapy Journal*" or "*American Journal of Hand Therapy*" (which was officially called the Journal of Hand Therapy) was accessed by 18.8% (6) of the sample. The American Journal of Occupational Therapy was accessed by 9.4% (3). One of these respondents accessed numerous articles (some already mentioned above), including the Journal of Hand Surgery, The Australian and Scandinavian OT Journals and other rehabilitation journals, Archives of Physical Medicine and Rehabilitation "*etc*". 6.3% (2) of the respondents accessed the South African Journal of Occupational Therapy, which was included in OTASA membership. One of these respondents said she accessed the South African Journal of Hand Therapy – but such a journal did not exist. It was possible that she meant the journals provided by SASHT (BJOT).

As one can see from Figure 19 (the dark blue column), journal / discussion groups which were attended by 59.4% (19) of the respondents, were utilized mostly quarterly, by 25% (8), then in 15.6% (5) of the cases, biannually. Monthly attendance or annual attendance occurred in 6.3% (2) of the cases respectively. Only one participant (3.1%) stated that she attends journal or discussion groups weekly and another one (3.1%) stated fortnightly.

In-service training (the mid-blue column in Figure 19) was a much more popular method of accessing education materials and occurred in 90.6% (29) of the cases – the same amount as those that accessed textbooks. 18.8% (6) of the sample attended this training annually and a further 18.8% (6) attended biannually. The majority (37.5% or 12 participants) attended in-service training quarterly, whereas 12.5% (4) attended monthly. Only 1 participant (3.1%) attended weekly.

Conferences (the light blue column in Figure 19) were attended by 62.5% (20) of the sample – the same figure as those that accessed hard copy journals. 40.6% (13) attended conferences annually, 15.6% (5) attended biannually, and only one (3.1%) participant stated she attended conferences quarterly and another monthly.

Post graduate level training (the yellow column in Figure 19) was being pursued by 28.1% of the sample (9 participants), of which 12.5% (4) marked this as an annual event, 9.4% (3) marked it as a daily occurrence, and 3.1% (1) indicated they participate in this monthly or fortnightly, respectively.

Under other responses, one therapist stated she accessed SASHT resources monthly and yet another commented that her department made use of the Tygerberg Protocol and they did not "*really question it*".

A final space for general comments was allowed at the end of the questionnaire and 6 therapists added comments. One stated that "*flexor tendons are more complicated to treat than extensor tendons and needs careful, intensive and regular therapy and supervision.*" Another said "*It's really scary and I have poor confidence in all hand therapy, often with regards to how sensitive it is to treat and how you can mess up so easily.*" Communication with the surgeon or "*timeous*" referral, the patient's responsibility/insight/cooperation, and employer compliance were seen as important factors,

in varying degrees by three different therapists. Another therapist commented that she had been trialling a new protocol in London, where they were incorporating more wrist mobility.

Chapter 5

Discussion

The aim of the study was to investigate the flexor tendon rehabilitation protocol use amongst Occupational Therapists in South Africa.

The objectives of the study were, all of which were achieved:

- To determine the nature of protocols, if any, that have been used by South African Occupational Therapists working in Hand Therapy in the treatment of clients with flexor tendon repairs
- To establish the therapist's knowledge of and preference for particular protocols, regardless of whether these have actually being used in clinical practice (achieved in various parts of the research)
- To establish reasons behind the OT's choice of protocol
- To establish whether protocol use differed across sites of practice within the South African context, and if so, why?
- To establish whether experience levels affected the choice of protocol

The literature review included old and new studies, and suggested that flexor tendon rehabilitation has been firstly, a much discussed and debated topic, and that protocols have changed and adapted over the decades, with some therapists and surgeons returning to older protocols as the newer ones have not always proven to be more effective. The information gathered from the 32 participants who completed the questionnaire indicated that they thought they were doing the following protocols, achieving the first objective:

- Duran, Modified Duran or Modified Duran and Houser, which was a passive mobilization protocol – passively flexing and passively extending the fingers in the splint for 6 weeks and weaning thereafter – [18.8% (6)],
- Kleinert or modified Kleinert, which was a passive flexion protocol (but labelled an active mobilization protocol in much of the literature as it allows active extension of the fingers in the splint) – [25% (8), although two therapists graded [active] mobilizations with the Kleinert],
- Early Active Mobilization or Early Active Controlled Mobilization, which was an active mobilization protocol, allowing active flexion and extension of the fingers within in splint – [28.1% (9)], and
- Immobilization – [3.1% (1)].

The second objective was achieved in various elements of the survey results.

The survey asked when the therapists mobilized the patients' wrist and fingers. Only 23.3% (7 participants) immobilized the fingers from week 1, with no one immobilizing the fingers beyond week 3.5, thus total immobilization for 6 weeks was not being utilized. This was extremely valuable information as many of the surgeons that therapists worked with in clinical practice, often referred patients late or had a tendency to immobilize the fingers for 3 weeks or more, even though research demonstrated clearly that this has not been recommended. Emphasis should be placed on *early* referral from surgeons to therapists for rehabilitation. However, in the state sector, there have often been transport problems for the patients, and so the therapist would see the patient while admitted in the ward post operatively, and then only at the first out-patient follow up with the doctors for removal of stitches, which could be anything from 10 days to 3 weeks post operatively, and on occasion, even longer. This could result in the patient remaining in the plaster cast for an extended period of time, and thus being immobilized. Problems such as this should be addressed by tertiary hospital therapists outsourcing the rehabilitation to clinicians in the community clinics. Shear and Bear-Lehman (1989) stated that 3 weeks of immobilization did not facilitate intrinsic healing and tendon vascularity, but mobilization resulted in increased DNA content in the sheath and tendon repair site and an improved reorientation of the blood vessels. Tang (2007) maintained that immobilisation regimes have become outdated amongst specialists, which was confirmed in Ewing Fess and McCollum's 14 year old article, published in 1998, who stated their concern about immobilising structures for long periods, as did Cyr and Ross (1998). Tang (2007) said that unfortunately generalists were still using these immobilization regimes. Thus the percentage of participants in this current study, who utilised some form of immobilization, was representative of what research confirms. In fact, one of the two therapists who was still immobilizing the fingers at week 3, mentioned she did this due to the nature of her patient compliance issues, transport problems in the rural area, and her and the surgeon's preferences, both in the private and state setting, but that she would like to try dynamic splinting (Kleinert regime) on Zone II injuries to reduce adhesion formation. This suggested that different approaches needed to be considered in the different settings (achieving the fourth objective) where access to therapy and compliance were factors mitigating against proper monitoring. This was consistent with what has been reported in *Rehabilitation of the Hand and Upper Extremity* (Hunter et al, 2002).

Elliot et al (2005) and Hunter et al (2002) mentioned that even experienced therapists do at times immobilize patient's hands with flexor tendon injuries for 3-4 weeks, especially young children and those with associated injuries and patients who were unable to comply with a home programme or when sufficient supervision was not possible. But in this survey, only 6.7% of the respondents were still immobilizing the fingers at week 2 and 3.

Some research has shown that it could be preferable not to mobilize before day 5. Zhao et al (2005) did a canine study and their results showed no tendon ruptures in the group that began mobilizing on day 5, but 8 tendons ruptured in the group that began on day 1. (They did not have a comparative group that began passive mobilization on day 3). Twenty five (83.3%) of the respondents from this survey commenced passive mobilization of the fingers in the protective splint during week 1 and 2. Galanakis et al (2003) said that early (day 3, 4 or 5) protected passive mobilization, achieved optimal hand function after Zone II primary flexor tendon repair. Hung et al (2005) began controlled active mobilization (flexion and extension) from day 3. This type of active mobilization commenced in week 1, was only performed by 30% (9 respondents) in the current study. Eighteen respondents (60%) of the sample were doing active flexion of the fingers in the splint at week 4 and passive range of motion of the fingers in the splint, was favoured by more than half of the respondents up until week 4. South African hand therapists in the study appeared to be commencing mobilization early, as available research has suggested. Progression of rehabilitation protocols in the South African context, as found in this small study, mirrored that of the global trend and is encouraging.

Elliot et al (2005) said that even some experienced therapists in the United States of America used a passive mobilization protocol, when other protocols may have been preferred, if conditions did not allow for direct supervision and regular therapeutic contact. They commented that in Zone I and II repairs, pushing to achieve full passive flexion in week 1 could be painful but that by week 2, full passive range of motion should be achieved, so that the effect of load on the repaired tendon could be reduced.

In a very early study by Young and Harmon (1959), they stated that prior to the 1960's, immobilization for at least one week was the accepted method for rehabilitation, but that they had moved away from this, beginning a type of Kleinert Protocol with early active extension of the fingers against a pulley system that facilitated passive flexion of the fingers. Chang et al (2006) likewise used the Kleinert type splint for 3 weeks and then removed it in week 4-5. In

this current study, the therapists stated that they used the Kleinert in 12.5% (4) of the cases, and the modified Kleinert in a further 12.5% (4) of the cases - one therapist did graded mobilizations with the Kleinert and one combined the Kleinert with early active mobilization. This represented a quarter of the sample, who continued to use a protocol developed in the 1950/60's, although 6.7% (2) of these had stated that they were moving away from the traditional protocol, by incorporating active or graded mobilization. It appeared that the more experience the therapist had, the greater the chance she would make use of dynamic splint in conjunction with static splinting, although there was no statistical significance. This may have been due to the fact that these therapists qualified when the research about the Kleinert protocol was becoming widely accepted.

In terms of splint use, Braga-Silva and Kuyven (2005) removed the splint at 3 weeks. In the results of this current study, most therapists were still using the splint at 4 weeks (83.3%), but it was the more experienced therapists that were less likely to be using the splint full time at 3.5 weeks (although not a statistically significant difference). Chow et al (1988) used their splint for 6 weeks. The results seen above showed that 26.6% (8) of the sample were still using the splint at 6 weeks. Chow et al's (1988) research was a few decades old and it appeared from the results of the survey, that there was a trend to move away from splinting for a full 6 weeks. Tang (2007) preferred a rehabilitation protocol that discontinued the splint or used it only at night, from week 5 or 6. In this current study, 33.3% (10) were still using the splint full time at 5 weeks and 50% (15) were using it for high risk or protective use at this time, whereas 56.7% (17) were using it for high risk or protective use during week 6.

The analysis of '*experience*' that was completed in various sections of the questionnaire contributed to determining the fifth objective of the study.

The study done by Braga-Silva and Kuyven (2005), advocated 10 repetitions of the active flexion and extension exercises every hour in a 16 hour period, beginning 12 hours after tendon repair, but in this current study, at week 1 post tendon repair, only 30% (9 respondents) were allowing active flexion of the fingers. 60% of the sample did active flexion of the fingers out of the splint, with their patients, from week 5, which increased until 9 weeks, where the amount of therapists doing this action dropped to 53.3% (16) until week 10, and by week 11 and 12, only 50% (15) were making use of active flexion of the fingers out of the splint.

This current study revealed that most therapists tended to position the splint from 0-3 weeks, with the wrist in 20°, the MCPj's in 70°, and the fingers (IPj's) in 0° or full extension. From 3-6 weeks, they tended to position the wrist in 10°, the MCPj's still in 70°, and the fingers (IPj's) in 0° or full extension. Those that continued to use the splint after 6 weeks, positioned the wrist in 0° or neutral, with a range of -15° to 10°, the MCPj's in 50° and the IPj's in 0° or full extension. In the literature, not all articles specified the position of the splint – some only named the splint (for example the "*Kleinert type splint*" or the "*Duran type splint*"). Galanakis et al (2003) used a splint with the wrist in 30° flexion, the MCPj's in 70° - 90° flexion, and allowed unhindered extension of the fingers. Braga-Silva and Kuyven (2005) used a splint with the wrist in "30°-60°" flexion, the MCPj's in 90° flexion and the IPj's in full extension, which they removed in the third week. Tang (2007) used a splint with wrist flexion of 20°-30°, MCPj's in "*slight flexion*" and IPj's in extension until week 2.5. Thereafter, the splint was changed to incorporate wrist extension of 30°. Hung et al (2005) used a splint with the wrist in 40° flexion, MCPj's in 70° flexion, and the IPj's in full extension.

The researcher had personally observed from clinical practice, that if one actually measured the angles of the splint, it was very difficult to achieve 90° MCPj flexion, but this position has often been referred to in literature. If one compared the results of this current study with research, the therapists that responded, tended to keep the MCPj's and IPj's in the position suggested by research, but tended to be more lenient with the wrist position. One therapist altered the wrist position of the splint after 6 weeks to allow wrist extension of 15°, which concurred with what Tang (2007) suggested, although she changed the wrist position later than he suggested and placed it in less extension. The principle of the tenodesis effect was evident here. Hunter et al (2002) similarly referred to the altering of the wrist position from slight flexion to slight extension in a splint allowing tenodesis.

The IFSSH flexor tendon committee report, edited by Elliot et al, (2005) stated that active flexion and extension protocols have become more commonly used in the United Kingdom, and were cost effective and "*user-friendly*". It has been perceived to be a risky protocol, as active flexion may have placed more strain on the repair than passive mobilization would, but the rupture rates had been about 5% - the same as that of the Kleinert regime. Elliot et al (2005) reference Savage (although a dated article was not included in the reference), who showed that active flexion of the fingers, with the wrist in 20°-30° extension, required the least effort, yet

clinicians still tended to use older methods of rehabilitation. In the United Kingdom, it was recommended that the splint allowed no more than 20° wrist flexion, although it did not seem of critical importance what position the MCPj's were in – the range was 45° to 80°, averaging at about 60°. In the United States of America, there seemed rather to be a trend to position the wrist in the splint, as close to neutral. Twenty years ago, they had put the wrist in 30° flexion. However, to reduce the tension when flexing the fingers with the wrist in flexion, some would splint the wrist in slight extension. It was anecdotally accepted that the IPj's were allowed full extension.

Elliot et al (2005) noted a trend towards EAM protocols in the United States of America, stating that "*experienced hand therapists who keep current with the literature express a preference for early active mobilization.*" These therapists commenced aggressive active flexion, should the patient have minimal tendon glide at week 3 and 4. Some, however, had varying definitions of what exactly active flexion was: some used "place-hold" or "active-hold" or "early active flexion", which was understood to be passive flexion of the finger followed by active contraction of the muscle to hold the finger in this position. Some used synergistic movement, as described by Tanaka et al (2005), and some used straight forward active flexion of the fingers in the therapy session, with or without an active flexion home programme.

The majority of the respondents in this study were happy with the effectiveness of the splint and mobilization protocols in achieving an aesthetic and functional outcome in "most" of the cases, and none of the respondents felt their choice of protocol was totally ineffective. Most of the respondents would not change their splinting or mobilization protocol. Establishing the reasons for the choice of protocol was the third objective. The respondents reason for '*always*' choosing the specific protocol was, (stated in ranked order): personal preference (25% or 8 participants), Doctor's request (18.8% or 6 participants), departmental protocol (15.6% or 5 participants) and recent training courses (15.6% or 5 participants), undergraduate training (9.4% or 3 participants), and finally, supervisor's request (3.1% or 1 participants). As Joubert suggested in her 2005 article, expert opinion was a valuable source of guidance in assisting therapists who may have had misgivings.

Tang (2007) emphasized the important role therapists played in the success of surgery, but many therapists in this study were influenced by the Doctor's request more so than their personal preference, suggesting the need for therapists to develop more confidence and greater

independence in decision making around their treatment protocols. However, it was interesting to note that in terms of environmental influences on the choice of protocol, confidence in skill was the main constant influence on the choice of the protocol used, where 21.9% (7) of the sample said it "always" influenced their choice, suggesting that confidence in practice has an important influence upon decisions taken.

Time available was the second highest factor in "always" influencing the protocol choice, with 18.8% (6) of the sample indicating this option. Available splinting materials and patient–therapist ratios "always" influenced the protocol choice in 15.6% (5) of the cases. Available additional materials (such as Velcro, fishing line for dynamic splints as used in the Kleinert regime, and other materials), available equipment (such as electrical equipment and tools) "always" influenced the protocol choice by 12.5% (4) of the sample and 9.4% said that therapist / practice funding was the main reason influencing the choice of protocol. Sadly, research trends "always" influenced the therapists' choice of protocol in only 9.4% (3) of the cases. The fact that the resources available had a greater influence on the therapists choice of protocols, confirmed Joubert's (2005) concerns about the difficulties therapists experience in resource accessing within the South African context.

Green (2004) emphasized the importance of evidence over tradition. In the South African context, it has not always been conducive to access or participate in research. Some clinicians in South Africa, particularly those working in rural areas, may not have been able to access internet and library resources regularly or as easily as in the urban settings, as facilities have been insufficient, non-existent or hard to access in rural parts of South Africa (Joubert, 2005). This had been changing but, therapists could benefit from consulting more experienced therapists and some of these therapists may have participated in, or run courses or in-service training. Dawes (2005a) stated that materials studied at university level had often been out of date by the time one completed the course, because textbooks tended to be several years outdated by the time they were published. He emphasised the need to share CATS within the profession.

In this current study, only two educational sources were accessed daily, of which textbooks were one (accessed by 6.3% or 2) and post graduate level training was the other (9.4%). Textbooks were referenced by a total of 90.6% (29). The most regularly accessed resources, besides textbooks – on a weekly basis – were internet journal articles (6.3%) and journal or

discussion groups (3.1%), and in-service training or courses (3.1%). In-service training was attended by 90.6% (29) of the sample – the same amount as those that accessed textbooks. Journal or discussion groups were attended by 59.4% (19) of the respondents. Internet journal articles were accessed by 50% of the sample, with only 3.1% or 1 respondent accessing Cochrane. Hard copy journals were accessed by 62.5% (20) and conferences were attended by 62.5% (20) of the sample. Post graduate level training was being pursued by 28.1% of the sample (9 participants). It was encouraging to see that more than half of the therapists regularly participate in some form of continuing education, but many still reference outdated sources, such as textbooks. Expert opinion (Joubert, 2005) and research was accessed in the form of in-service training, conferences, journal or discussion groups and journal articles.

Interestingly, 43.8% said they would possibly change their protocol in an "ideal situation" and 12.5% said they definitely would change it. Conditions in South Africa have not always been conducive to first world medicine but the opportunity and resources have become more readily available. Garner et al (2004) stated that the infrastructure in South Africa lent itself to the ability to change. Rehabilitation protocols used by therapists in this study did represent the global trend as briefly reviewed in the literature review for this mini dissertation. However, therapists lacked the regular and intensive contact with research that would influence their therapeutic approaches and this was often due to the occupational overload and lack of access to resources, as suggested by Joubert (2005) and Watson and Buchanan (2005). It could therefore be important to instil confidence in therapists, at university level, and through courses and post graduate training, that their choice of methods would be effective in producing functional and aesthetic outcomes, and to continue to keep abreast of updated research and expert opinion. Assisting therapists in being more assertive about what they have experienced, as being successful in practice, would be helpful, so that they can put their arguments confidently to referring doctors and take more control of what they do in therapy.

In summary, Occupational Therapists in South Africa have generally been staying within the norms regarding protocol usage and splint position, as described in the literature. They should perhaps access more of the recent research available, more regularly, and make better use of training opportunities, allowing these courses to influence their therapeutic approaches. Finally, they would benefit from having confidence in their approaches to rehabilitation, a characteristic that could be nurtured from an undergraduate level right through all modes of training.

Chapter 6

Conclusions and Recommendations

6. 1. Contributions of the study

Surveys and audits have been helpful in determining current trends of practice, as well as identifying the areas of knowledge lacking in the field. These could be helpful in guiding academic institutions in focusing their training on the current trends and supplementing areas where knowledge has been lacking, both in the under-graduate and post-graduate fields. This study has suggested a slight favouring, by the Occupational Therapists, of the EAM or CAM protocols of the flexor tendon post repair, although the Kleinert regime was still a preferred method by some.

A review of the literature revealed that older research tended to show a leaning towards the use of Kleinert and Duran techniques. However, current research has revealed the benefits of EAM protocols, but the outcomes have not appeared to show significantly more benefits than those of the more traditional approaches. Past and current research had, however, indicated that immobilization was not advised for prolonged periods of time.

Within the South African context, the following typical problems have been reported:

- Therapists had to deal with delays in referrals from doctors post injury or surgery, and thus delayed presentation of the patient, commencing rehabilitation later than week 1.
- Problems related to regularity and sustained therapy attendance as a result of patients experiencing problems with transport and finances, when compared with the apparent regularity of therapy attendance reported in overseas journals.
- There had often been a concern, that should there be a problem with a splint (especially one with a pulley system), the patient may not have been able to return for some time. Thus splints were sometimes simplified by the therapists, such as using a straight forward dorsal protective splint as used in the Duran protocol.
- Some mobilization protocols required intensive monitoring by a therapist, or required a certain degree of compliance and insight from the patient. Thus protocols that suited these requirements were often used. This may have varied from therapist to therapist,

as some feel EAM was more easily controlled and complied with, whereas other therapists feel early passive mobilization worked better.

Ultimately, most therapists were happy with their outcomes, regardless of which protocol they used. This information may be helpful for the younger therapists working with hand patients, who feel overwhelmed by the complexities of the condition and the treatment protocols. Sometimes, all one needs, as a therapist, was reassurance that one was using a protocol that would be effective, with minimal side effects, and was appropriate for the specific patient population.

6. 2. Limitations of the study

a. Surveys have been notorious for poor response rates. 32 out of a possible 182 (from OTASA who treated hand injuries and made splints), or a possible 139 (from SASHT) was a poor response rate, of which 81.2% (26) worked in private practice, and thus the study may very well have been biased towards the trend of preferred treatment methods in private practice, possibly with more compliant patients, who have the insight into an early active mobilization protocol.
b. This study only asked preferred methods and did not quantify the actual outcomes of these methods – in other words, the sense of success was subjective.
c. Elements of the questionnaire could have led to bias – for example not specifying whether the PROM (passive range of motion) was in extension of flexion, and by not asking whether the therapists used the pulley system advocated by the Kleinert regime. (They were only asked to name the regime or whether they used a dynamic splint.) There was some ambiguity in certain questions in the questionnaire that was only identified at the end of the study, during statistical analysis.
d. This study was not able to comment on EBP with regards to flexor tendon rehabilitation as subjective opinions and personal preferences were obtained from the sample.

6. 3. Recommendations

Further studies could be conducted by taking information gathered from this survey, and using some of the respondents' future patients (with flexor tendon injuries) to specifically quantify

the outcomes of the various protocols used, namely Duran, Kleinert, EAM and others, for example in the form of an audit of therapeutic outcomes.

SASHT and OTASA could provide an ethics and support committee for encouraging therapists to do minor research, audits and surveys in their clinical settings, and publish their findings, to contribute towards the body of research in the South African context.
An undergraduate study could be completed to actually measure the splints made by therapists for the rehabilitation protocol, and to comment on the trend of splint positioning in therapeutic practice. A study could be done with therapists making and measuring their own splints, evaluated by a control.

There is a need for a pooling of a massive amount of available evidence regarding the most effective treatment methods of these type of injuries. No meta-analyses or systematic reviews had been done to date of data gathering – the Cochrane Collaboration did begin one but withdrew it subsequently (reason unknown to researcher). Standardising of the terminology would be a recommendation.

Universities need to keep abreast of studies and updated textbooks, and not recommend outdated textbooks for students. Universities need to build the confidence levels of students so they recognise their knowledge and skills, and know when to ask for advice. This can be done by positive feedback sessions in clinical practice, outside of exam or tutorial sessions.

Therapists in clinical practice need to build their own confidence in the use of flexor tendon rehabilitation protocols. This could be done by feedback sessions from colleagues or by doing a departmental audit to evaluate the success of protocols used on past patients. Confidence could be boosted by working in a team, and by having in-service training, whether the practice/department was small or large. Community Service OT's could be invited to feedback and support sessions by their local regional hospital to build their confidence.
Therapists needed to know that the efficacy of various protocols was fairly similar, according to research, and therefore whatever influences there were on the therapist's choice of protocol, it would most likely not be critical to the success of the therapy.

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Appendices

Appendix 1. Operational definitions and abbreviations

ADL's – Activities of daily living ie. Any activity a person participates in their day to day life, including work, leisure activities, sleep, personal maintenance and hygiene.

CAM – Controlled Active Mobilization – a method of mobilizing the hand post flexor tendon repair, which requires a balance between active extension with passive flexion, as per literature, although some therapists may use the term when referring to active flexion and extension of the fingers, as well as passive mobilization.

CATs – Critically Appraised Topics – a short summary of evidence by means of integrating methods, findings, study limitations and practical implications of a group of articles on a topic or clinical question.

CPM - Controlled Passive Mobilization (also known as the Duran and Houser method) – a method of mobilization the hand after flexor tendon repair, but means of strict passive movements at regular intervals.

Distal interphanageal joint (DIPj) – the last of furthermost joint of the finger.

Duran's protocol – a passive mobilisation protocol post flexor tendon repair.

EAM – Early Active Mobilization - a method of mobilizing the hand post flexor tendon repair, which consists of active mobilization of the fingers. Some therapists may use this term when incorporating active flexion and extension of the fingers and others use this term when only doing active extension of the fingers during rehabilitation post flexor tendon repair.

EBP – Evidence-based practice – the integration of the best available research evidence and applied to the clinical setting,

ECM – Early Controlled Mobilization - a method of mobilizing the hand post flexor tendon repair, which usually is considered as being a passive mobilization method, but some therapists may use this term when incorporating active extension and flexion of the fingers.

Extension – movement of a joint, resulting in straightening of the limb or body part.

Flexion – movement of a joint, resulting in bending of the limb or body part.

Flexor tendons – the tendons that result in bending of the limb or body part.

Flexor Digitorum Superficialis (FDS) – the tendon that causes flexion of the finger from the middle joint.

Flexor Digitorum Profundus (FDP) – the tendon that causes flexion of the finger from the tip.

Hand Therapy – the art and/ or science of treatment of the upper limb. (See **Therapy)**

Interphalangeal joint (IPj) – joints of the fingers, excluding the knuckle joint.

Kleinert Regime – a specific flexor tendon rehabilitation protocol involving passive flexion of the fingers and active extension of the fingers within a splint and time period

Metacarpal Phalangeal joint (MCPj) – the knuckle joint in the hand.

Occupational Therapists (OT's) – persons qualified with an allied health degree enabling them to treat clients with injuries or diseases, of a physical or psychological nature, to enhance human occupation in all activities of daily life, in a meaningful manner.

Physiotherapists / Physical Therapists – Persons qualified with an allied health degree enabling them to treat clients with injuries or diseases, of a physical nature, primarily by using biomechanics to enhance human functioning.

Protocol – a prescribed course of medical treatment, an established code of procedure or behaviour in a situation, a system or planned way of doing things, or more specifically, a regimen of prescribed movements and periods of rest or immobilisation during a fixed time period and with specific instruments, splints and interventions.

Proximal Interphalangeal joint (PIPj) – the joint in one's fingers between the furthermost joint and the knuckle joint.

Rehabilitation – the restoration of an injured or disabled person into a functional and / or productive place in society.

Strickland's grading system:

$$\frac{\text{(PIP+DIP) flexion} - \text{(PIP+DIP) extension deficit} \times 100}{175} = \%\text{ of normal active PIP + DIP motion}$$

Synergistic wrist movement – a movement pattern described in literature as how to mobilise the hand and fingers to cause differential glide between the FDP and FDS tendons, namely a movement sequence of 1) the wrist flexed in 60° with the MCPj's and the IPj's in full extension, followed by 2) passive flexion of the fingers with the wrist still flexed in 60°, followed by 3) extension of the wrist to 60°, still with the fingers in full flexion, and 4) gradual extension of the MCPj(s) to 45° with the IPj's still flexed.

TAM – Total Active Motion: an assessment method of using total active flexion minus the total extension deficit of the MCPj, PIP, and DIPj. This was worked out as a percentage by dividing the TAM of the injured finger by the TAM of the contra-lateral uninjured finger.

Tendon – a flexible but inelastic cord of strong tissue attaching a muscle to a bone.

Tenodesis / tenodesis effect – a movement pattern caused by the way muscles and tendons attach to the fingers, in other words, when the wrist was flexed, the fingers passively extended and when the wrist was extended, the fingers passively flexed.

Therapy – treatment required to heal or relieve a disease, disorder or injury.

Appendix 2. Instruments

Appendix E (as per ethical submission labelling) **– Consent Form**

Consent form

Regarding the Flexor Tendon Rehabilitation Protocol Research to be conducted by Jane Venter, registration no: 209540341 as a requirement for her Masters in Hand Rehabilitation at the University of KwaZulu Natal:

I have been adequately informed about the above research and hereby give the researcher permission to use the information that I am willing to provide on the attached questionnaire. I understand this information will be kept in a private and confidential storage facility and that my identity will be kept anonymous in the reporting process. Furthermore, I understand that there are no risks to my participation in the research. I thus willingly give consent to complete the questionnaire and participate in this study, and reserve the right to withdraw at any point. I understand this information will be used for research and may be published.

Returning the questionnaire implies consent. As this is in electronic format, I will keep a copy of the consent form, letter and questionnaire and return the completed questionnaire and consent form by email or fax.

Full Names: …….. Date: ……..

(This form will be in duplicate so you will be able to keep the copy)

Jane Venter, Occupational Therapist, Masters student at UKN
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Cell: 084 652 0176, fax: 044 874 0127, Email: mrsjaneventer@gmail.com

For further information contact Jane Venter,
or her supervisor, Prof Robin Joubert (tel: 031 260 7309, cell: 083 482 1799, joubertr@ukzn.ac.za)
or her co-supervisor, Ancil Prinsloo (082 736 9945, saprotea@telkomsa.net).
Research Ethics Committee of UKZN: Faculty of Health Sciences, Westville Campus, P/Bag X 54001, Durban 4000

Appendix A (as per ethical submission labelling) **– Questionnaire**

Questionnaire
for Occupational Therapists regarding knowledge and views of Flexor Tendon Rehabilitation Protocols.

Thank you for agreeing to complete this questionnaire.
Guidelines for Questionnaire completion

- Please answer all the questions
- Completion of this questionnaire will take you approximately 15 - 20 minutes
- Mark the block that is most applicable with a cross (X)
- Certain questions require expansion. In these cases, please write your answer out in full in the space provided
- Your name is not required, ensuring anonymity
- All raw data received will be treated with confidentiality
- A goniometer may be helpful for completion of Questions 11.

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or her co-supervisor, Ancil Prinsloo (082 736 9945, saprotea@telkomsa.net).
Research Ethics Committee of UKZN: Faculty of Health Sciences, Westville Campus, P/Bag X 54001, Durban 4000

Section A - Biographical details

1. Gender

Male		Female	

2. Age

21-25	26-30	31-35	36-40	41-45	46+

3. Years qualified (or part thereof)

0 – 0.5	0.6 – 1	2 – 3	4 – 5	6 – 10	11 – 15	16 -20	21+

4. Years experience in the field of hand therapy, in years (tick relevant block(s) – as close an approximation as possible)

	0 – 0.5	0.6 – 1	2 – 3	4 – 5	6 – 10	11 – 15	16 -20	21+
Part time								
Full time								

5. Approximate number of hours of hand therapy currently practiced per week , treating patients comprehensively (ie manufacturing splints and providing rehabilitation)

0 – 1 hours	
2 – 3 hours	
4 – 5 hours	
6 – 8 hours	
9 – 16 hours	
17 – 24 hours	
25 – 32 hours	
33 – 40 hours	
41 + hours	

6. Current site of work, doing hand rehabilitation (tick as many as is appropriate)

Government hospital – Tertiary	
Government hospital – Regional	
Government hospital - District	
Government hospital - Clinic	
Private practice – own practice	
Private practice – employed	
Non-governmental Organisation	
Academic Institution	
Other	
Please specify:	

7. Additional Qualifications
(key: BAHT – British Association of Hand Therapy
CHT – Certified Hand Therapist)

Diploma of Hand Therapy	
Masters of Hand Therapy	
Doctorate of Hand Therapy	
BAHT level I	
BAHT level II	
BAHT level III	
CHT (American)	
Diploma in other field	
Please specify:	
Masters in other field	
Please specify:	
Doctorate in other field	
Please specify:	
Short Courses	
Please specify	

Section B - Occupation Specific Practice

The following questions can be answered in generalised terms describing the Rehabilitation Protocol **most commonly** used by yourself, when treating adult clients with uncomplicated Flexor Tendon injuries, post operatively. **Disregard complicated cases, for example, when the client has associated injuries, and adaptations need to be made to the protocol.**

Details regarding splintage

The word "splint" in these questions refers to any apparatus used to position the injured hand and/or facilitate movement, and may be made of various materials (thermoplastic, plaster-of-paris, backslab or other).

8. Do you splint or supervise the splinting of your client?

Yes		No	

9. Splint site:

Dorsal		Volar	

10. Splint type:

Static		Dynamic		Both	

11. Splint programme used for a typical client – please mark appropriate block(s) with an "X":

	Splint full time	Splint –night use / high risk	Tenodesis cuff
Week 1			
Week 2			
Week 3			
Week 3.5			
Week 4			
Week 5			
Week 6			
Week 7			
Week 8			
Week 9			
Week 10			
Week 11			
Week 12			
Not applicable			
Other			
Please specify			

12. Please document the splint positions most commonly used in the table below, in degrees:

	0 - 3 weeks	3 – 6 weeks	6 weeks plus
Wrist			
MPj			
IPj			

13. Does the Protocol used, have a name?

Yes		No		Unsure	

14. If so, what is the name of Protocol: _____

Details regarding the use of mobilisation

Please answer the questions below regarding the mobilisation methods <u>most commonly</u> used, whether it is overseen by yourself or a physiotherapist. Mobilisation is considered active if the client is actively contracting muscles to move the finger in partial or full range, and considered passive if an external force is used to mobilise the finger, be it a pulley, the therapist's or the client's hand. PROM stands for "Passive Range of Motion", and implies mobilisation of all joints of the finger.

15. Mobilisation programme used <u>for fingers</u> – please mark the appropriate block(s) with an "X":

	Immobilisation	PROM of fingers <u>in splint</u>	PROM of fingers <u>out of splint</u>	Active flexion of fingers <u>in splint</u>	Active flexion of fingers <u>out of splint</u>	Active extension of fingers <u>out of splint</u>
Week 1						
Week 2						
Week 3						
Week 3.5						
Week 4						
Week 5						
Week 6						
Week 7						
Week 8						
Week 9						
Week 10						
Week 11						
Week 12						
Other						
Please specify						

16. Mobilisation programme used **<u>for wrist</u>** – please mark the appropriate block(s) with an "X":

	Immobilisation	PROM of wrist <u>in splint</u>	PROM of wrist <u>out of splint</u>	Active flexion of wrist <u>in splint</u>	Active extension of wrist <u>out of splint</u>
Week 1					
Week 2					
Week 3					
Week 3.5					
Week 4					
Week 5					
Week 6					
Week 7					
Week 8					
Week 9					
Week 10					
Week 11					
Week 12					
Other					
Please specify					

17. Does this Protocol used, have a name?

Yes		No		Unsure	

18. If so, what is the name of Protocol: _____

Section C - Personal Preferences and Views

19. Do you think the splinting protocol you have mentioned above, is effective in producing a fully functional and aesthetic outcome?

Always		Most of the time		Some of the time		Never	

20. Do you think the mobilisation protocol you have mentioned above, is effective in producing a fully functional and aesthetic outcome?

Always		Most of the time		Some of the time		Never	

21. Rank the reason for the choice of protocol(s).

	Always	Most of the time	Some of the time	Never
Doctor's request				
Departmental protocol				
Supervisor's request				
Personal preference				
Undergraduate training				
Recent training course				
Medico-legal cases				
Other				
Please specify:				

22. Would you prefer to use another splinting protocol, other than that used in your current situation?

Yes		No		At times	

State reason for your answer, and if applicable, please name your preferred protocol: _____

_____

_____

23. Would you prefer to use another mobilisation protocol, other than that used most regularly?

Yes		No		At times	

State reason for your answer, and if applicable, please name your preferred protocol: _____

_____

_____

Section D - Environmental Influencing Factors

24. What environmental factors currently affect your choice of protocol?

	Always	Most of the time	Some of the time	Never
Splinting materials available				
Additional materials available (Velcro, fishing line, etc)				
Time available				
Medical aid funds available				
Practice / Therapist funds available				
Available equipment				
Patient – Therapist ratios				
Current research trends				
Confidence in skill				
Other				
Please specify:				

25. In "an ideal situation", would you change your choice of protocol?

Yes		No		Maybe	

If you replied "yes" to this question please give reasons for this, and if applicable, please name your preferred protocol: _____

_____

26. What educational resources do you use? *(You may mark as many as are appropriate).*

	Daily	Weekly	Fortnightly	Monthly	Quarterly	Biannually	Annually
Hard copy journal articles							
Please specify which journals:							
Internet journal articles							
Please specify which search engines / websites you use:							
Textbooks							
Journal /discussion groups							
In-service training / courses							
Conferences							
Post graduate level training							
Other							
Please specify:							

27. Any additional comments you would like to make regarding flexor tendon injury intervention?

_____

_____

Thank you so much for participating in the study!

Please return the questionnaire electronically to the email address below, or by hitting reply.

Send to: mrsjaneventer@gmail.com or fax to: 044 874 0127

Appendix 3. Covering letters

Originally labelled as follows for ethical approval (order rearranged for logical progression):

- **Appendix C – Letter to participants**
- **Appendix D – Letter to heads of Occupational Therapy departments**
- **Appendix B – Letter to OTASA and SASHT**

- **Appendix C – Letter to participants**

School Of Audiology, Occupational Therapy

And Speech-Language Pathology

Telephone: +27 (0)31 2607309
Facsimile: +27 (0)312607261
Email: joubertr@ukzn.ac.za
Website: www.ukzn.ac.za

UNIVERSITY OF KWAZULU-NATAL

Letter to participants

15th May 2011
Re: Flexor Tendon Rehabilitation Protocol Research

"Evidence Based Practice" is becoming the new buzz word within health care. But time, cost and inclination affect our involvement in research, and thus not many of us actually do any research.

I have put together a questionnaire, as part of my mini dissertation for my Masters degree in Hand Rehabilitation, and would appreciate your help in completing it. The questionnaire is straightforward and will take less than 30 minutes to complete. It is 5 pages long and there are between 4 and 7 questions per page. Simply, return the completed questionnaire by email or fax by 30 June 2011. This will be an opportunity for you to contribute to research with no cost to yourself. The findings will also be emailed to you once they have been processed.

The research is an investigation to establish flexor tendon rehabilitation protocol use amongst Occupational Therapists working in South Africa. This will contribute towards directing education and training, and treatment trends in clinical practice.

Confidentiality will be maintained by encrypting electronic information and all completed questionnaires will be kept under lock and key when not being analysed. Data will only be accessible to the researcher and supervisors. There is no cost or risk to yourself with completing the questionnaire. You have the right to withdraw at any point. **Returning the questionnaire implies consent.**

If you have any questions, please do not hesitate to call or email me. Thanking you in anticipation!

Kind Regards

Jane Venter

Prof RWE Joubert
Supervisor

For further information contact Jane Venter (cell: 084 652 0176, fax: 044 874 0127, mrsjaneventer@gmail.com, Kingswood Golf Estate, Suite 27, George, 6529),
or her supervisor, Prof Robin Joubert (tel: 031 260 7309, cell: 083 482 1799, joubertr@ukzn.ac.za)
or her co-supervisor, Ancil Prinsloo (082 736 9945, saprotea@telkomsa.net).
Contact details of the Ethics Committee of UKZN: Faculty of Health Sciences, UKZN, Private Bag X 54001, Durban 4000.

- **Appendix D – Letter to heads of Occupational Therapy departments**

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UNIVERSITY OF KWAZULU-NATAL

Letter to heads of Occupational Therapy departments

To whom it may concern

Re: Flexor Tendon Rehabilitation Protocol Research

"Evidence Based Practice" is becoming the new buzz word within health care. But time, cost and inclination affect our involvement in research, and thus not many of us actually do any research.

I have put together a questionnaire, as part of my mini dissertation for my Masters degree in Hand Rehabilitation. I would appreciate your authorization to secure the cooperation of your department's Occupational Therapists, who treat clients with hand injuries, to help in completing it. The questionnaire is straightforward and will take less than 30 minutes to complete. It is 5 pages long and there are between 4 and 7 questions per page. The completed questionnaire can be returned by email or fax. This will be an opportunity for you and your therapists to contribute to research with no cost to yourself or your department. The findings will also be emailed to you once they have been processed.

The research is an investigation to establish flexor tendon rehabilitation protocol use amongst Occupational Therapists working in South Africa. This will contribute towards directing education and training, and treatment trends in clinical practice.

Confidentiality will be maintained by encrypting electronic information. Data will only be accessible to the researcher and supervisors. There is no cost or risk to yourself or your department. Your therapists have the right to withdraw from the study at any point.

If you have any questions, please do not hesitate to call or email me. Thanking you in anticipation!

Kind Regards

Jane Venter

Prof RWE Joubert
Supervisor

For further information contact Jane Venter (cell: 084 652 0176, fax: 044 874 0127, mrsjaneventer@gmail.com, Kingswood Golf Estate, Suite 27, George, 6529), or her supervisor, Prof Robin Joubert (tel: 031 260 7309, cell: 083 482 1799, joubertr@ukzn.ac.za) or her co-supervisor, Ancil Prinsloo (082 736 9945, saprotea@telkomsa.net). Contact details of the Ethics Committee of UKZN Faculty of Health Sciences, UKZN, Private Bag X 54001, Durban 4000.

- **Appendix B – Letter to OTASA and SASHT**

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UNIVERSITY OF KWAZULU-NATAL

Letter to OTASA / SASHT

To whom it may concern

Re: Flexor Tendon Rehabilitation Protocol Research

"Evidence Based Practice" is becoming the new buzz word within health care. But time, cost and inclination affect our involvement in research, and thus not many of us actually do any research.

I have put together a questionnaire, as part of my mini dissertation for my Masters degree in Hand Rehabilitation, and would like to email it to all Occupational Therapists on your database that deal with the physical arena of treatment, and who are proficient in English. I would appreciate it if you could send me a list of the email addresses of the relevant Occupational Therapists in order for me to email them the questionnaire. I have attached a copy of the questionnaire for your perusal.

The research consists of an investigation to establish flexor tendon rehabilitation protocol use amongst Occupational Therapists working in South Africa. This will contribute towards directing education and training, and treatment trends in clinical practice. Should you wish, a copy of the findings could be made available to you on completion of the research.

Confidentiality will be maintained by encrypting electronic information. Data will only be accessible to the researcher and supervisors. There is no cost or risk to Occupational Therapists, or to the society. The therapists have the right to withdraw at any point.

If you have any questions, please do not hesitate to call or email me. Thanking you in anticipation!

Kind Regards

Jane Venter

Prof RWE Joubert
Supervisor

For further information contact Jane Venter (cell: 084 652 0176, fax: 035 340 2430, mrsjaneventer@gmail.com, Kingswood Golf Estate, Suite 27, George, 6529), or her supervisor, Prof Robin Joubert (tel: 031 260 7309, cell: 083 482 1799, joubertr@ukzn.ac.za) or her co-supervisor, Ancil Prinsloo (082 736 9945, saprotea@telkomsa.net). Contact details of the Ethics Committee of UKZN: Faculty of Health Sciences, UKZN, Private Bag X 54001, Durban 4000.

Appendix 4. Ethical approval

UNIVERSITY OF
KWAZULU-NATAL
University of KwaZulu-Natal
Research Office
Govan Mbeki Centre
Westville Campus
University Road
Chiltern Hills
Westville
3629
South Africa
Tel No: +27 31 260 8200
Fax No: +27 31 260 2384
E-mail : naidoos4@ukzn.ac.za

07 February 2011

Mrs N J J Venter
School of Occupational Therapy
WESTVILLE CAMPUS

Dear Mrs Venter

PROTOCOL: An investigation to establish the flexor tendon rehabilitation protocol use amongst Occupational Therapists in South Africa
ETHICAL APPROVAL NUMBER: HSS/0017/2011 M: Faculty of Health Sciences

In response to your application dated 04 February 2011, Student Number: **209540341** the Humanities & Social Sciences Ethics Committee has considered the abovementioned application and the protocol has been given **FULL APPROVAL.**

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

Professor Steve Collings (Chair)
HUMANITIES & SOCIAL SCIENCES ETHICS COMMITTEE

SC/sn

cc: R Joubert (Supervisor)
cc: Mr. S Reddy