Master of Medicine (MMed)

in Plastic and Reconstructive Surgery

Submitted to:
University of Cape Town
Faculty of Health Sciences

Percutaneous Puncture of Flexor Sheath Ganglions: An Assessment of Recurrence

Submitted by:
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ACKNOWLEDGEMENT

I would like to thank *Dr Shameem Jaumdally* for his assistance with the statistical analysis and layout.

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PART A: PLAGIARISM DECLARATION

I, ***Azzaam Najjaar***, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

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Date: 20-12-2019

PART B: ETHICS APPROVAL LETTER

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
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Email: Olivia.langenhoven@uct.ac.za
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11 November 2019

HREC REF:782/2019

Prof Donald Hudson
Department of Plastic and Reconstructive Surgery
H53 OMB GSH

Dear Prof Hudson

PROJECT TITLE: PERCUTANEOUS PUNCTURE OF FLEXOR SHEATH GANGLIONS: AN ASSESSMENT OF RECURRENCE (MMED DEGREE - DR A NAJJAAR)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 November 2020.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledges that the student: Dr A. Najjaar will also be involved in this study.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC REF in all your correspondence

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
NHREC-registration number: REC-210208-007

PART C: STUDY PROTOCOL

Purpose of the Study

The study will evaluate the recurrence rate of flexor sheath ganglions managed by way of percutaneous puncture and attempt to compare this method to a surgical alternative.

Methodology

Study Design

The study will be retrospective in nature.

Study Population

Patients will be identified from clinic records. These patients' follow-up notes will be surveyed to assess whether or not lesions had recurred at follow-up assessments. Percutaneous ganglion puncture is to have taken place at least six months prior to the data collection date.

Inclusion Criteria

1) Flexor sheath ganglions managed by way of percutaneous puncture
2) Patients older than 18 years
3) Time since puncture of more than six months

Data Collection

Follow up clinical notes will be assessed.

Informed Consent

The study data will be obtained from clinical notes that form part of routine patient care and follow up assessment. Complete patient anonymity will be maintained in the handling of data. For this reason, no consent was required.

Confidentiality

In order to ensure strict anonymity, no names or other identifying particulars of participants are used in any part of the study. All data is held in strict confidence.

PART D: LITERATURE REVIEW AND REFERENCES

Search Algorithm Development

- Search engines used to acquire the relevant journal articles:
  - PubMed
  - Medline
  - Google Scholar

- Search words and phrases used:
  - flexor sheath ganglion
  - ganglion
  - hand tumour
  - hand mass
  - millet seed ganglion
  - pearl-seed ganglion
  - sesamoid ganglion

- Related citations suggested by the search engines were used.

- Only articles written in English were used.

- References cited in journal articles obtained were used to further broaden the search and evaluated for pertinence to the topic.

INTERPRETATION OF THE LITERATURE

Ganglion cysts are a common presenting complaint encountered by hand surgeons and make up between 50-70% of hand and wrist masses. The most common ganglions are found in the dorsal and volar wrist. Flexor tendon sheath ganglions (FTSG) make up between 5-16% of this total [1].

Epidemiology

FTSG are uncommon in children and occur predominantly in adults [2]. The youngest reported patient diagnosed with FTSG was 7 months old [2]. In adults, they were found to occur predominantly in females in their 30s-50s [2,3]. The female to male prevalence rate is 2.6 to 1. This female bias is probably due to the desire for cosmetic perfection amongst women, so they are more likely to notice and be bothered by its presence and appearance when asymptomatic [3].

Pathology and Pathogenesis

The pathogenesis of ganglions is largely unclear, although many theories have been proposed.

One theory holds that ganglions are formed by herniation of the synovial lining in which a one-way valve mechanism is created [4].

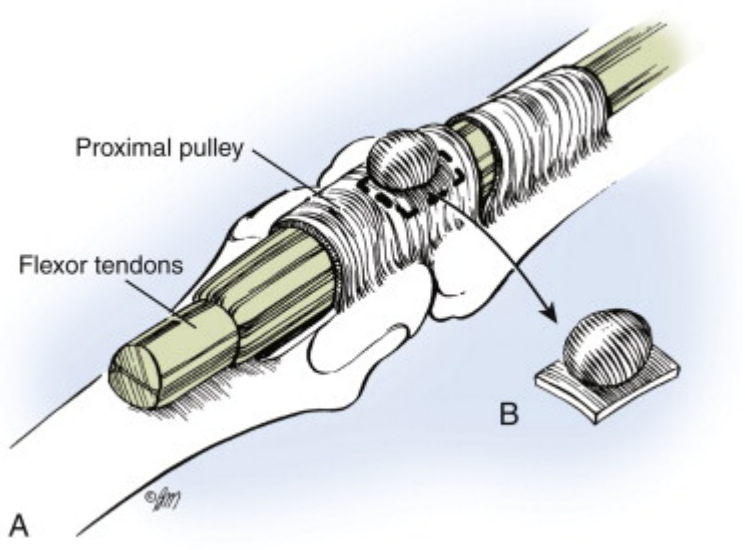
Another postulates that ganglions are benign tumours of synovial origin [4].

A third theory proposes that a fissure in the joint capsule or tendon sheath allows leakage of synovial fluid, which inflames the surrounding tissue to create a pseudocapsule and subsequently a ganglion. The reaction between this tissue and the synovial fluid produces the

ganglion fluid. The ganglion then enlarges as fluid is pumped in and then decreases in size as the water component is resorbed [4].

A fourth theory postulates that ganglions occur secondary to mucoid degeneration of connective tissue, with breakdown products of collagen, which amalgamate to form large cysts. This concept explains the microcysts that may be seen in the tissue surrounding the main stalk of a cyst in surgical specimens [4].

Another theory suggests that recurrent stress and microtrauma at the synovial capsular interface stimulates mesenchymal cells or fibroblasts to produce mucin [5].



Volar retinacular ganglion in situ on the proximal annular ligament (A1 pulley) of the flexor tendon sheath. B, Excised specimen with a surrounding margin of tendon sheath [16]

Ganglions are comprised of thin walls containing viscous or gelatinous material. At a microscopic level the walls are composed of fibrous tissue with lining membrane and the pedicle contains a tortuous lumen [2,6].

On gross pathological examination of FTSG, a valve-like structure was observed between the sheath and the ganglion, similar to that found in ganglia of the wrist [7]. FTSG are dome-shaped masses between 3-8mm and are in continuity with the tendon sheath. They were found to be unilocular, with no cystic offshoots [2].

Presentation

Ganglions are typically located adjacent to joints and tendons. The most common sites in the hand and wrist are the dorsal wrist, volar-radial wrist, dorsum of the distal interphalangeal (DIP) joint and the proximal digital flexion crease [4].

FTSG arise mainly in the area of the A1 pulley but can also arise in the area of the A2 pulley, and also in the area between the A1 and A2 pulleys [1]. In a study by Abe *et al*. (2004), the middle finger was the most common location comprising 34.3%. Thumb, index and ring fingers followed almost equally with the counts of 18.7%, 20.9% and 18.7%, respectively. The little finger was the least involved digit [8]. It is very rare for a FTSG to occur in two different fingers simultaneously [2]. They are usually small and not visible but are easy to palpate and do not move with tendon excursion. FTSG are usually solitary and asymptomatic, but can be painful and interfere with hand function and grip strength [9,10]. The pain experienced by the patient is often disproportionate to the size of the FTSG [1]. FTSG may compress digital nerves, which can cause numbness or pain [4]. Saleeb *et al.* (2016) reported an unusual presentation in a single patient with a large painless multiloculated swelling of the little finger with numbness of the fingertip [11].

Aetiology

It is postulated that trauma plays a role in the formation of FTSG. The fact that the middle finger is most commonly involved with FTSG (since it plays a great role in daily hand function), supports this theory. Trauma results in an increase in intrasynovial pressure and weakening of the collagen structure of the sheath itself [8]. Matthews (1973) also supports the trauma-related theory in his series in which, the middle finger was the most affected and the ganglion was located at the level of the A1 pulley in a sample of typists [2]. On the contrary, Al-Khawashki & Hooper (1997) and Angelides (1993) do not support the link between repeated trauma and the pathogenesis of FTSG [7, 9].

Management

Conservative

When asymptomatic, FTSG may be observed [12].

The management of symptomatic ganglions is either by way of percutaneous rupture or open surgical excision. The literature is equivocal as to which holds true superiority, hence there is no consensus with regard to its management [1].

Percutaneous Puncture

Various techniques for percutaneous puncture have been described and vary mainly in terms of the use of lignocaine, sclerosant or corticosteroid injection, and post-operative mobilisation/immobilisation protocols [2]. Abe *et al.* (2004) injected local anaesthetic to the skin overlying the ganglion followed by multiple percutaneous punctures of the ganglion wall [8]. Mathews (1973), in his series of five patients employed the technique described by Bruner - a wheal of subcutaneous local anaesthetic followed by percutaneous puncture [2, 13]. Turan

et al. (2013) used a 21-gauge needle attached to a syringe containing 0.5ml of local anaesthetic to rupture the cyst wall [12].

Abe *et al.* (2004) reported a recurrence rate of 89% in patients treated with percutaneous aspiration [8]. Oni (1992) showed that percutaneous aspiration reduces the need for surgery by 16% [14]. Bruner (1963) showed good results with percutaneous rupture. In his series of 15 patients, he had only noted one recurrence [13]. Turan *et al.* (2013) showed 89.3% success rate with percutaneous puncture, with surgery offered to FTSG that recurred on repeat puncture [11].

Open Excision

Turan *et al.* (2013) and Jebson *et al.* (2007) made use of the same surgical technique. By way of their technique, patients received a tourniquet to allow for a bloodless operative field. They received either local or regional anaesthesia (Bier's block). Loupe magnification was used. FTSG were exposed by way of a volar Bruner incision. The radial and ulnar digital neurovascular bundles were isolated and retracted. The ganglion was identified and excised with a surrounding margin of tendon sheath. Sheath closure was not performed. The skin was closed with nonabsorbable suture and a non-restrictive dressing was applied [1, 12].

Abe *et al.* (2004) made use of a transverse incision directly over the FTSG which was traced to the tendon sheath. It was excised including an elliptical section of flexor sheath containing the perforation root [8]. Abe *et al.* (2004) demonstrated a cure rate of up to 100% with this technique [8]. Patients undergoing surgery reported a return to normal activity after surgical excision [1].

Complications

Conservative Management

Complications with conservative management are rare [4].

Percutaneous Puncture

Surgical excision has been advocated over aspiration because of the potential for digital nerve injury, the high recurrence rate following aspiration, and the recognized complications of skin depigmentation and subcutaneous atrophy following the use of corticosteroid injection [1].

Turan *et al* (2013) reported two patients in his cohort who experienced post-puncture localised tenderness and one with permanent paraesthesia due to ulnar nerve injury [11].

Open Excision

Surgery brings with it the potential disadvantages of a high scar burden, decreased range of motion, incisional tenderness, cold sensitivity, neurovascular injury as well as a potential risk of recurrence despite being a more invasive procedure [1,15].

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PART E: ABSTRACT

Background

Flexor tendon sheath ganglions (FTSG) comprise up to 15% of hand ganglions. The management is split between two schools of practice: percutaneous puncture or surgical excision. The literature is equivocal as to which holds true superiority in terms of recurrence rates. The cost of surgical excision is higher and the recovery is longer. In addition, surgery also brings with it the potential for surgical complications, both immediate and long term. Percutaneous puncture can be performed at the time of the initial consult and an immediate return to normal activity with no down-time for the patient. The aim of this study is to assess the recurrence rate after percutaneous puncture. We also describe our employed technique.

Method

The technique for percutaneous puncture involved the use of a 25-gauge needle for ganglion puncture, no sclerosant or corticosteroid was injected, and an immediate post-procedure mobilisation protocol was employed. Patients were identified from clinical records and were followed up at a minimum of six months to check for recurrence.

Results

Eighteen patients were included in the study, 12 females and 6 males. The majority of FTSG were found to occur in the middle finger. Two patients experienced a recurrence. Both were successfully treated with a repeat puncture. No patients experienced a complication.

Conclusion

In our study, we show a low recurrence rate obtained with percutaneous puncture of FTSG using a simple technique. No complications were noted in our cohort on follow-up. We, therefore, recommend employing it as a first line treatment in the management of FTSG.

PART F: MANUSCRIPT FOR PUBLICATION

INTRODUCTION

Ganglions are the most common hand and wrist tumours, making up a total of 60% of the total hand and wrist tumours. Flexor tendon sheath ganglions (FTSG) account for 5-16% of these[1].

Although the youngest reported patient diagnosed with FTSG was 7 months old, they occur predominantly in females in their 30s-50s [2,3]. The female to male prevalence rate is 2.6 to 1 [2,3].

FTSG are usually asymptomatic but can present as a painful firm mass that may interfere with hand function and grip strength [4]. It may also present with triggering of the involved digit [1].

It is postulated that FTSG occur secondary to synovial herniation. A valve-like structure occurs between the sheath and the ganglion similar to that found in ganglia of the wrist [5]. FTSG were found to be dome-shaped masses between 3-8mm and are in continuity with tendon sheaths. They were unilocular with no cystic offshoots and comprised of thin walls containing viscous or gelatinous material. At a microscopic level the walls are composed of fibrous tissue with lining membrane [2]. The aetiology is unknown. There is no clear relationship to occupation or repeated trauma [2].

Management is either by way of percutaneous puncture or surgical excision. There is no consensus with regard to the ideal management. In our clinical practice, at a tertiary level hospital, we employ percutaneous puncture as the first line of treatment.

In this study we assess the recurrence rates using percutaneous puncture, and also describe our technique. Secondary objectives and end-points captured for this study also include: (1) gender prevalence of FTSG, (2) recurrence rate across gender, (3) time-to-recurrence, (4) assessment of recurrence with repeat puncture, (5) most commonly involved finger (6) cost-to-patient and (7) complications with puncture.

METHODS

Participant Recruitment

Patient folders were surveyed to obtain a cohort of patients that had undergone percutaneous puncture for FTSG. Inclusion criteria for this study were patients who were older than 18 years at the time of the procedure and patients who had undergone puncture more than 6 months prior to a follow-up assessment. A retrospective cohort of 18 patients was obtained employing these criteria.

Data Collection

Data collected included age at time of puncture; finger involved; number of aspiration; time since puncture; complications. If recurrence occurred: at what time interval after initial aspiration; incidence of second recurrence. Patients that did not present for clinical follow-up were followed-up telephonically. In the case of telephonic follow-up, verbal consent was obtained.

Percutaneous Puncture Technique

The clinical diagnosis was made at initial consultation and, percutaneous puncture was performed in the same setting.

The technique employed was as follows:

With the hand placed on a sterile paper sheet, the area was cleaned using a cotton wool ball soaked in antiseptic solution (Chlorhexidine/Alcohol solution). A 25-gauge needle was used to puncture the ganglion which was then massaged in order to 'milk out' the ganglion contents. A non-bulky dressing was applied in order to allow immediate full range of mobilisation. No local anaesthetic, sclerosant or corticosteroid was used.

Photograph 1. below depicts the basic consumables required for the puncture.

Procedure Requirements:
Sterile paper sheet
Sterile gloves
Antiseptic solution
Cotton wool ball
25-gauge hypodermic needle

Photograph 1 : Consumables required for puncture

Cost

We assessed cost of both surgical excision as well as percutaneous puncture in our setting. Surgical excision of FTSG would entail an initial consultation, a pre- and post-op visit, day surgery theatre time and theatre consumables. In state practise, because patients are billed according to income, it would cost the patient a minimum of R550/US$37 (for low income

patients) and a maximum of R4000/US$274 (for high income and private paying patients). The cost of the surgical procedure in private practice was estimated to be approximately R30 000/US$ 2000 at the time of the study write-up.

Percutaneous puncture would entail, a clinic visit, minor consumables needed for puncture and a follow-up visit. In state practice patients would only be billed for a consult. The cost of a consult would also be determined by income. For a low-income patient this would cost R20/US$1,4 and for a high-income patient it would be R290/US$20. In private practise, patients would get billed for a consultation as well as consumables.

Statistical Analysis

Explorative univariate statistical analysis of data was performed using GraphPad Prism version 5 (GraphPad Prism version 7.00 for Windows, GraphPad Software, La Jolla California USA, www.graphpad.com). Mean, standard deviation and range will be used to describe measures of central tendency and dispersion for data of a parametric nature. The non-parametric equivalents used will be median and interquartile range. Groups of data parametric in nature will be compared using a normal t-test while the non-parametric test for comparing non-parametric groups will be the Mann-Whitney test. A Kaplan-Meier curve will be generated to assess the survival function for recurrence of the pathology.

RESULTS

A total of 18 patients (**Figure F.2**) met the inclusion criteria and formed part of the study. This included 12 females and 6 males. The mean age of the patients was 38. The male participants' age at time of puncture ranged from 18 to 43 years (mean age 33.5 years). Female participants' age at time of puncture ranged from 32 to 56 years (mean age 40 years). There was no

significant difference in age between males and females in this study (**Figure F.3**). In two patients a recurrence was noted, one at 6 months and the other at 5 months post-puncture. These patients were offered a repeat puncture. With repeat puncture these patients did not have a recurrence at follow-up. Time since puncture varied among participants and ranged from 7 months to 8 years.

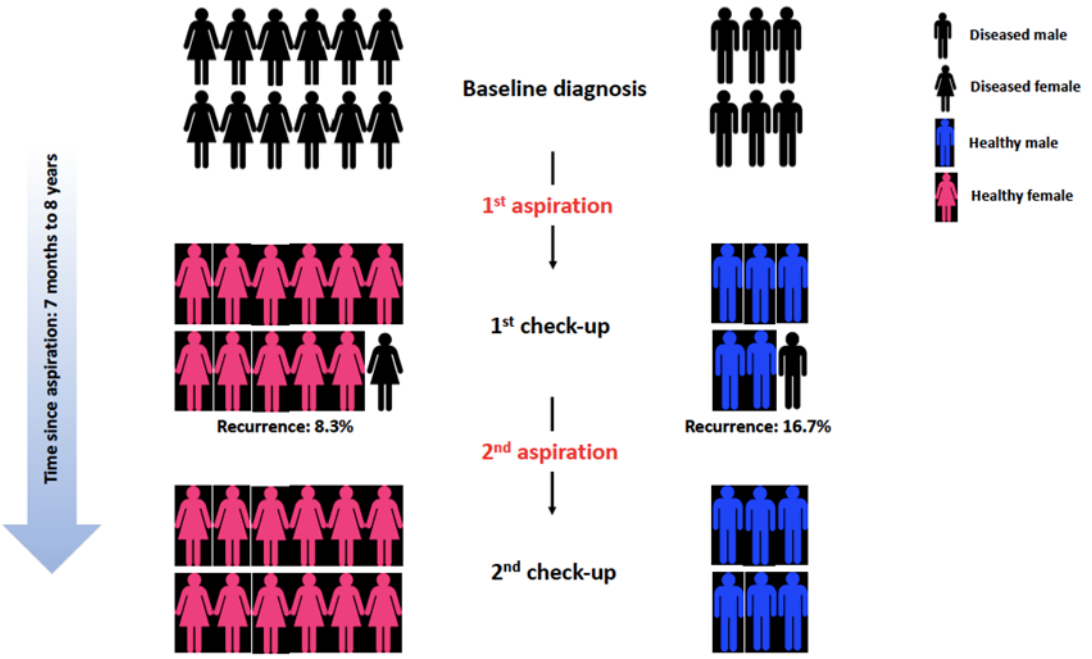


Figure F.1: Breakdown of participants enrolled in study and follow-up outcomes.

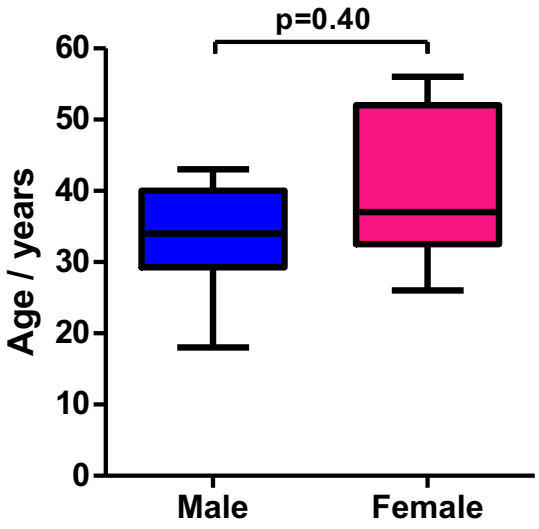


Figure F.2: Age distribution across gender.

The age of participants in each group of individuals is depicted by box-and-whisker plots indicating the median (middle line), 25th (bottom line) and 75th percentiles (top line), and the range (whiskers).

The most common finger involved was the middle (n=10) followed by the ring (n=5) and then the little (n=3) finger. The index finger and thumb were not involved in any of the cases (**Figure F.3**).

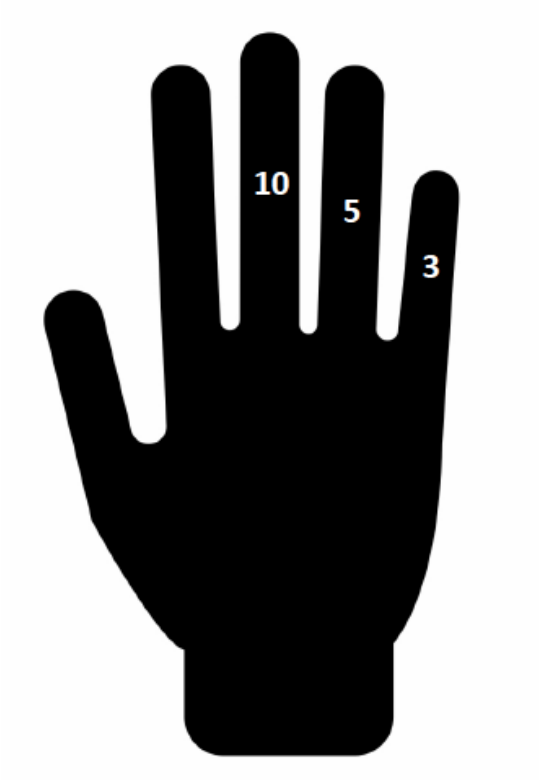


Figure F.3: FTSG distribution relative to finger.

There was no correlation found between age or gender of patient and involvement of a specific finger (**Figure F.4**).

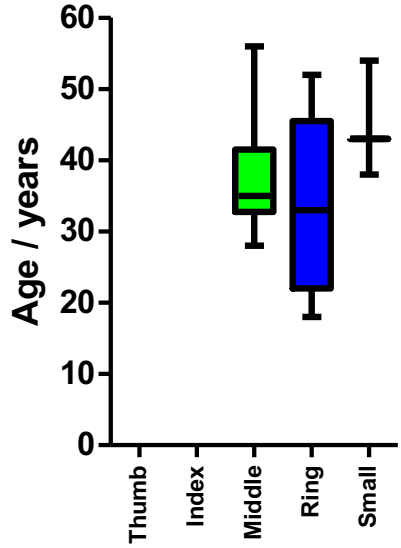


Figure F.4: Age of participants according to finger involvement.

The age of participants in each group of individuals is depicted by box-and-whisker plots indicating the median (middle line), 25th (bottom line) and 75th percentiles (top line), and the range (whiskers).

A Kaplan-Meier survival curve (**Figure F.6**) was generated to demonstrate the recurrence of ganglions in the participants, and is shown for the first year of follow-up. There was no recurrence recorded past the 12th month post-aspiration (1st aspiration).

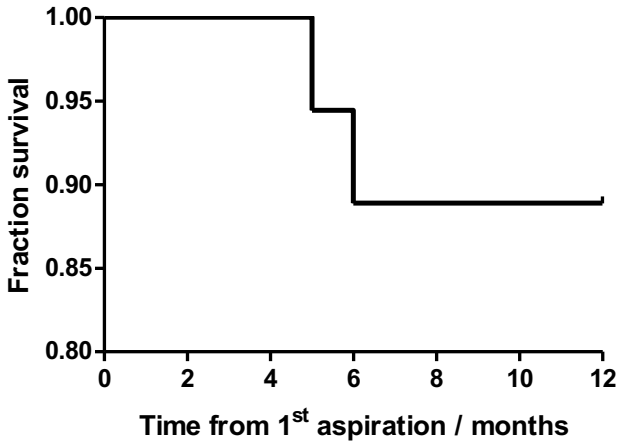


Figure F.5: Kaplan-Meier survival curve for recurrence of ganglion.

No complications were reported. Specifically, there were no cases of sensory loss.

	Puncture	Surgical Excision
Time of Procedure	5-10min	45-60min
Cost to Patient (State Practice):		
**Low Income Patients*	**R20/US$1,4	**R550/US$37
**High Income Patients*	**R290/US$20	**R4000/US$274
Degree of Discomfort	Needle prick	• Injection of local anaesthetic • Post-operative pain
Recovery Time	Immediate return to normal activity	At least one week
Complications	• digital nerve injury [1] • skin depigmentation and subcutaneous atrophy following the use of corticosteroid injection [1]	• high scar burden • decreased range of motion incisional tenderness • cold sensitivity • neurovascular injury

***income categories according to tertiary institution hospital management board**

****as per costs provided by fees office**

Table F.1: Comparison of puncture versus surgical excision technique

DISCUSSION

The management of FTSG is split between two main schools of practice: percutaneous puncture and open surgical excision. The literature is equivocal as to which holds true superiority, hence there is no consensus with regard to its ideal management [1].

Our follow-up period ranged from seven months to eight years (with a mean of 36 months). Only two patients that had a recurrence presented for clinical follow-up. The rest of the cohort were followed-up telephonically.

Our study concurs with the findings of Abe *et al*. [8] that the middle finger (10 cases) is the most commonly involved digit, and the little finger is the least involved (3 cases).

Various techniques for percutaneous puncture have been described and vary mainly in terms of the use of lignocaine, sclerosant or corticosteroid injection, and post-operative mobilisation/immobilisation protocols [2].

When reviewing the literature there are many papers that have looked at percutaneous puncture. Mathews (1973), in his series of five patients employed the technique described by Bruner - a wheal of subcutaneous local anaesthetic followed by percutaneous puncture. He reported a 40% recurrence rate in patients followed up between 3 and 36 months [2, 6]. Bruner (1963) showed good results with percutaneous puncture. In his series of 15 patients, he had only noted one recurrence [6]. Oni (1992) showed that percutaneous aspiration reduced the need for surgery by a mere 16% [4]. In contrast, Turan *et al.* (2013) showed 89% success rate with percutaneous puncture, with a mean follow-up period of 11 months. Turan *et al.* (2013) used a 21-gauge needle attached to a syringe containing 0.5ml of local anaesthetic to rupture the cyst

wall [7]. Abe *et al.* (2004) injected local anaesthetic to the skin overlying the ganglion followed by multiple percutaneous punctures of the ganglion wall. In this series they showed 89% recurrence rate within 12 days to seven months [8].

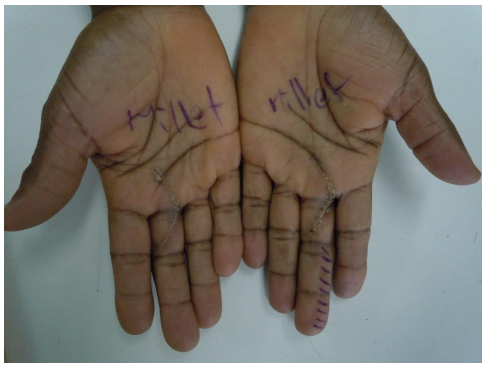
Our technique does not make use of local anaesthetic, sclerosant or corticosteroid. We employ a single puncture with a 25-gauge needle followed by massage of the ganglion to expel its contents. Patients are instructed to commence immediate mobilisation of the affected finger with no restrictions.

Our findings in terms of recurrence rates, are most closely matched to those of Turan *et al.* [7], who showed an 89.3% success rate with first puncture – we showed a recurrence in 2 of 18 patients (11%). However, after a second puncture, no recurrence was reported in our cohort. This is in contrast with Abe *et al* [8] who showed an 89% recurrence rate, but this technique involved local anaesthetic and multiple punctures.

Percutaneous puncture offers many advantages. It can be offered as part of a clinical consultation, with no theatre time required and the patient receives immediate treatment. The consumables used for our technique are minimal – sterile paper sheet; sterile gloves; cotton wool ball; 25-gauge needle; anti-septic cleaning solution. This is especially relevant in a state hospital service where one is limited by availability of theatre time and budget constraints. It has the additional benefit of no downtime for the patient. Our study did not demonstrate any complications in patients managed by way of percutaneous puncture.

In contrast, surgical excision comes at a higher cost when compared to percutaneous puncture. Post-operative incapacitation and recovery are significant factors, as well as the typical

potential complications associated with hand surgery. The following picture (Photograph 1) depicts some of the complications of open excision, including high scar burden (that can be seen in both middle fingers) that comes with a volar Bruner incision; and neurapraxia (involving the radial digital nerve of the patient's left middle finger). Other complications of open excision include finger stiffness, incisional tenderness, cold sensitivity and neurovascular injury [9].



Photograph 2. Patient operated at an outside institution. Presented to our clinic post excision with noticeable incisional scars and neurapraxia of his left middle finger (shaded).

***picture provided by Solomons M (co-supervisor)

Bittner *et al.* (2002) found that two attempts at aspiration followed by surgery was the most cost-effective approach [10]. The first attempt at aspiration was shown to have a higher cure rate than the second. Recurrence after the second attempt was followed by surgery [10,11].

Our cost analysis when comparing the two modalities of management puts forward a strong argument for using percutaneous puncture as a first line method of treatment.

Study Weaknesses

The fact that the study took the form of a retrospective analysis can be seen as a flaw. The variables measured were limited by the information that was previously recorded. Because the study aims to establish the outcomes of an intervention, it would have benefited from the use of a control group. Other factors that may play a role in choosing percutaneous puncture as a method of treatment of FTSG include pain induced by procedure and co-morbid illnesses in the study participants. These could not be consistently analysed retrospectively. Doing this study as a retrospective analysis also meant that routine periodical follow-ups to assess recurrence, resolution of symptoms or complications were not instituted.

A larger patient sample may have also strengthened the validity of the study.

Another weakness is that there is only a minimum 6 month follow up.

CONCLUSION

18 Patients with FTSG managed by way of percutaneous puncture were retrospectively reviewed. They had undergone a standardised puncture technique. This was followed by immediate post-procedure mobilisation. The technique employed was simple, and cost-effective, with the use of basic consumables.

Our series showed that using percutaneous puncture in the management of FTSG produced satisfactory outcomes - with no recurrences at a minimum 6 month follow up and no complications. We therefore recommend employing percutaneous puncture as the first line treatment in the management of FTSG.

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Percutaneous Puncture of Flexor Sheath Ganglions: An Assessment of Recurrence

Data Collection Sheet

Patient No.	Patient Age	Patient Sex	Finger	Aspiration No.	Recurrence (Yes/No)	When did recurrence occur?	Time Since Last Aspiration	Complications
1								
2								
3								
4								
5								
6								
7								