Modified trapdoor procedure versus complete nail removal for subungual glomus tumor excision at minimum 2 years follow-up

Asser Sallam, Mohamed Rakha

Department of Orthopedic Surgery and Trauma, Suez Canal University Hospitals, Suez Canal, Egypt

Correspondence to Asser Sallam, MD, PhD, Department of Orthopedic Surgery and Trauma, Suez Canal University Hospitals, Kilo 4.5 Ring Road, Ismailia 41111, Egypt
Tel: +20 109 527 7212;
Fax: +20 64 3220203;
e-mail: assersallam@hotmail.com

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Objectives
Various surgical approaches were described for excision of the subungual glomus tumors of the nail bed, including transungual, periungual, and nail-plate-preserving or nail plate non-preserving approaches. This study aims to assess the clinical outcomes, recurrence rate, and postoperative complications of our modified trapdoor technique, compared with complete nail removal approach.
Patients and methods
A retrospective study was conducted on 42 patients with subungual glomus tumor of the nail bed of the hand with a minimum follow-up period of 24 months. Twenty-two patients underwent modified trapdoor excision of the tumor. Twenty patients underwent excision of the tumor through complete nail-plate removal. Outcome measures included the 100-mm visual analog scale, cold sensitivity, nail discoloration, nail regrowth rate, infection, and local recurrence.
Results
A significant reduction in pain and cold intolerance was observed postoperatively for all patients. The mean postoperative visual analog scale was similar in both groups. Two patients with postoperative split nail deformity were noted in the nail removal group. Other two patients with severe nail deformation due to recurrence were observed, one in each group, in addition to other two patients with nail plate deformity due to infection, one in each group. Three patients with recurrence were reported in the nail removal group, and two patients in the trapdoor group.
Conclusions
Both techniques are safe and effective. The modified trapdoor procedure is better reserved for patients with small tumors, while complete nail removal is indicated for those with larger and aggressive tumors, especially in the presence of preoperative nail deformity.
Level of evidence
Therapeutic level III.

Keywords:
glomus, nail bed, nail preserving, nail sparing, subungual

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Introduction

Glomus tumor is a rare benign vascular soft tissue hamartoma that usually arises from hyperplasia of the subungual glomus body of the finger. The glomus body of the finger is a contractile neuromyoarterial structure normally located in the dermal retinacular layer and responsible for controlling blood pressure and temperature of the finger by regulation of the blood flow through arteriovenous shunting of the blood [1–3]. It is usually a solitary lesion commonly found in the distal phalanx, particularly in the subungual region, and represents about 1–5% of all hand tumors [2].

Diagnosis is mostly clinical by the existence of a symptomatic triad of stabbing paroxysmal pain due to the angiomatous tissue proliferation within a narrow nail bed, cold intolerance, and intense point tenderness. Bluish or reddish discoloration with or without nail-plate deformity is also a frequent presentation [4,5]. However, the glomus tumor is often misdiagnosed and improperly treated as many surgeons are unfamiliar with it [6].

Three main special tests are usually used for diagnosing the glomus tumor. Love's pin test, 100% sensitive with 78% accuracy, is performed by applying pressure to the suspected area using a pinhead. This would elicit exquisite pain over the area containing the glomus tumor. The second test is Hildreth's test, 100% specific and 71.4% sensitive with 78% accuracy, in which transient ischemia is induced by applying a tourniquet to the arm. Withdrawal of pain from the affected area indicates a positive test. This can be attributed to temporary ischemia as the tumor is vascular. Additionally, repeating Love's pin test will be painless

with the inflated tourniquet. On removing the tourniquet, the pain will return. The third is the cold-sensitivity test, 100% specific and sensitive with 100% accuracy, in which patients would feel increased pain when applying cold water or an ice cube to the affected area [1,7].

Precise preoperative localization of the tumor is the cornerstone for complete surgical excision [8]. Imaging studies such as ultrasonography [9] and MRI [10,11] are helpful in only one-third of the patients [12]. Plain radiography may show some bony erosions in long-lasting tumors [13–15].

Nail plate deformity and high recurrence rate may occur because of incomplete surgical excision of the tumor. Therefore, wide surgical excision is the only therapeutic option [8,16,17]. Various surgical approaches have been described in the literature, including transungual, periungual, and nail-preserving, or preserving approaches [1,4,16,18].

This study aims to assess the clinical outcomes, recurrence rate, and postoperative complications of our modified trapdoor procedure, compared with complete nail removal approach.

Patients and methods

A retrospective comparative study (therapeutic level III) was conducted on 42 patients with glomus tumor of the hand, who presented to the hand surgery unit, in the period from June 2014 to August 2020, with a minimum follow-up period of 24 months.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (our institutional research board # 4818) and with the Helsinki Declaration of 1975, as revised in 2008 [19]. Informed consent was obtained from all patients included in the study.

Our inclusion criteria were patients with histologically confirmed solitary subungual glomus tumor in the nail bed. The diagnosis was, ultimately, based on the clinical presentation of the presence of severe intense pain at the tip of the finger, cold intolerance, and bluish discoloration beneath the nail. Positive Love's pin test [1,12] confirmed the diagnosis and aided in accurate preoperative localization of the tumor. Patients with multiple or recurrent tumors or lesions presented in other localizations were excluded. Plain radiography was performed to assess bone erosion or notching, especially in long standing lesions.

Twenty-two patients underwent modified trapdoor excision of the glomus tumor. Twenty patients underwent excision of the tumor through complete nail plate removal. Both groups were similar in all characteristics (Table 1).

The decision to carry out complete nail removal was taken when there was preoperative nail plate deformation or large tumor. If there was no deformity, we always performed a modified trapdoor technique.

Surgical technique

All surgeries were performed under a regional block and using a pneumatic forearm tourniquet, and magnifying loop.

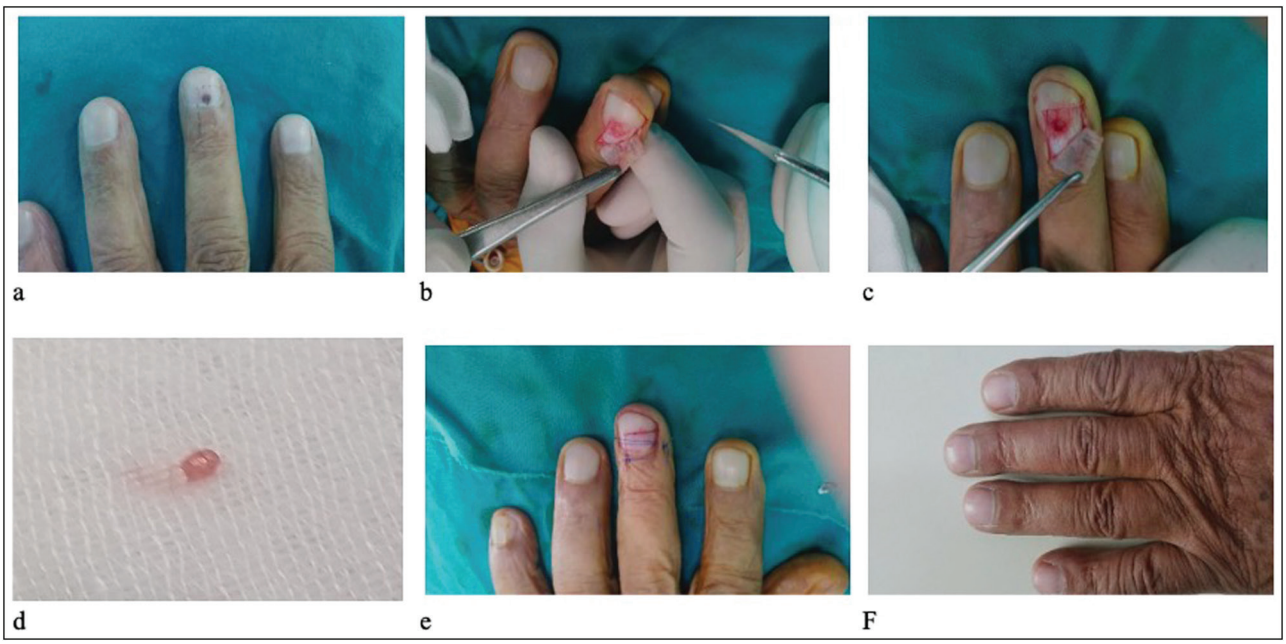
For the modified trapdoor group, a trapdoor window around the lesion is made in the nail plate and extends into the dorsal skin of the distal phalanx (Fig. 1a). The nail bed was longitudinally incised, and the tumor was identified using magnifying loops (Fig. 1b). The tumor was thoroughly excised using a small curette till reaching the bone surface (Fig. 1c and d). A precise repair of the nail bed was carried out using 8-0 absorbable suture and the elevated nail was relocated (Fig. 1e and f). A histopathological assessment of all excised lesions was ordered.

Table 1 Demographic and clinical characteristics of the study groups

	Modified trapdoor group	Nail removal group
Age (years)[a]	31.4 (18–65)	31.8 (19–64)
Male/female	8/14	7/13
Hand, right/left	13/9	12/8
Finger location of the lesion [*n* (%)]		
Thumb finger	4 (18.75)	3 (13.3)
Index finger	5 (25)	5 (26.7)
Middle finger	6 (31.25)	4 (20)
Ring finger	3 (12. 5)	5 (26.7)
Little finger	4 (12. 5)	3 (13.3)
Average duration before surgery (weeks)[a]	13 (1–32)	14 (1–30)
Preoperative bone erosion and cortical scalloping [*n* (%)]	8 (31.25)	6 (26.7)
Follow-up (months)[a]	28.5 (24–36)	27.5 (24–38)

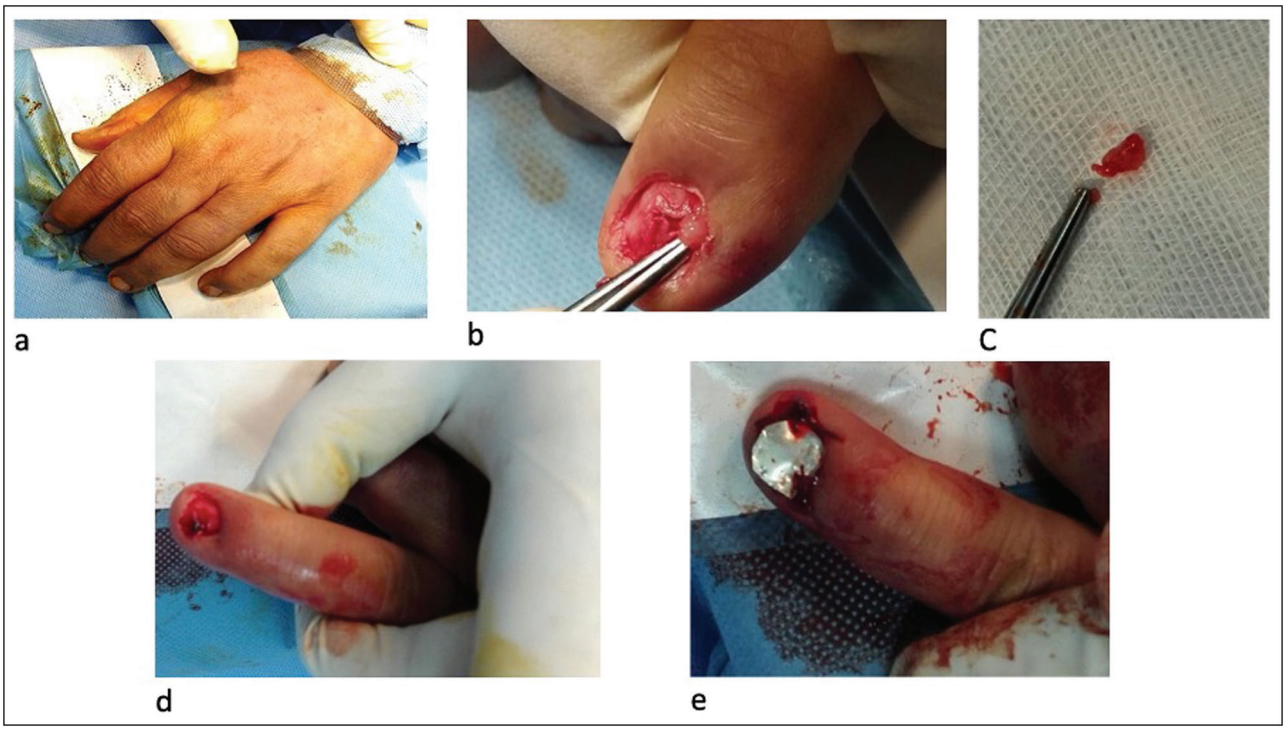
[a]Data are presented in mean (range)

Figure 1



Modified trapdoor excision of a subungual glomus tumor of a middle finger using a trapdoor procedure. (a) Localization of the glomus tumor using Love's pin test and drawing of the trapdoor. (b) Elevation of the nail trapdoor and exploration of the tumor. (c) Complete excision of the tumor using a small curette. (d) The resected tumor. (e) Nail repositioning after suturing the nail bed. (f) Nail appearance 4 months after surgery.

Figure 2



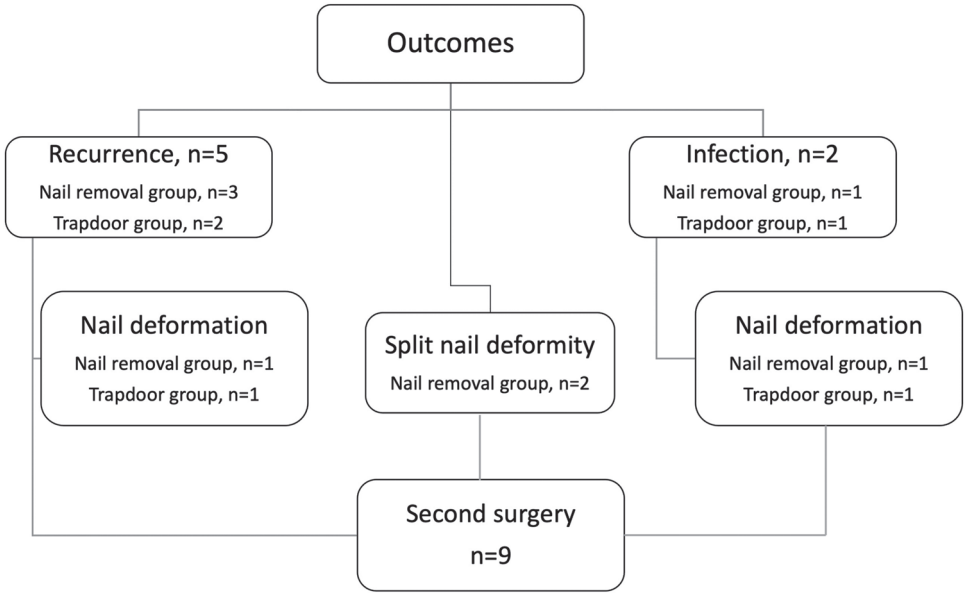
Complete nail removal and excision of a subungual glomus tumor of a little finger. (a) Localization of the glomus tumor. (b) Complete nail removal and identification of the tumor. (c) The resected tumor. (d) Closure of the nail bed. (e) Coverage of the nail bed by an aluminum sheet.

For the complete nail removal group, a transungual approach was performed as described by Tada *et al.* [20]. The nail plate was completely removed, and a longitudinal incision was made in the nail bed (Fig. 2a and b). After excision (Fig. 2c), the nail bed was meticulously repaired using 8-0 absorbable suture (Fig. 2d). Finally, the nail bed was covered by an aluminum sheet (Fig. 2e).

Postoperative care and follow-up

A compressive dressing was applied after surgery, and a free active range of motion of the affected finger

Figure 3



Nail deformity during follow-up.

was encouraged starting from the first postoperative day. Patients were followed up for a minimum of 2 years postoperatively. Outcome measures included assessment of pain using a 100-mm visual analog scale [21], cold sensitivity, nail discoloration, nail regrowth rate, infection, and local recurrence. The need for revision surgery was our secondary outcome.

Statistical analysis

Data were analyzed using JMP Pro 16 (SAS Institute Inc., Cary, North Carolina, USA). Descriptive statistics were summarized with frequencies and percentages or means and ranges. When comparing the clinical outcomes, the Wilcoxon signed-rank test was used. When comparing categorical data, χ^2 or Fisher-exact tests were applied. A P value of less than .05 indicated a significant difference between groups.

Results

A significant reduction in pain, point tenderness, and cold intolerance was observed postoperatively for all patients of both groups. The mean postoperative visual analog scale was similar in both groups [0.3 (0–1) in the trapdoor group, 0.4 (0–1) in the nail removal group].

Tumor size averaged 2.3 mm (1–4 mm) in the modified trapdoor group and 2.8 mm (2–5 mm) in the nail removal group.

Three cases of recurrence were reported in the nail removal group at the same location of the primary tumor, one skin-colored tumor after 5 months and the other two at 1 and 2 years after surgery, compared with one case of recurrence in the modified trapdoor group at 1 year after surgery. Another single case in the modified trapdoor group showed tumor regrowth in another location in the same finger 2 years after surgery (Fig. 3).

Two cases of postoperative split nail deformity were noted in the nail removal group. Other two patients with severe nail deformation due to recurrence were noted, one in each group, in addition to other two patients with nail-plate deformity due to infection, one in each group (Fig. 3).

The nail regrew after an average period of 4.6 (3–6) months in the nail removal group. In the modified trapdoor group, the nail window was united with the rest of the nail plate within an average period of 2.3 (1–3) weeks (Fig. 3).

The average duration of symptoms before the initial operation was 13 (1–32) weeks for modified trapdoor patients and 14 (1–30) weeks for nail removal patients. In nail removal patients with tumor recurrence, symptom duration was 18 (8–30) weeks. The modified trapdoor patient with tumor recurrence symptoms lasted about 16 weeks before initial surgery. Age, sex, tumor size, and preoperative bony erosion had no potential risks of recurrence in both groups (P>0.05). Table 2 summarizes the clinical and demographic data of patients with tumor recurrence in both groups.

Nail discoloration and cold intolerance were encountered in all patients with recurrent tumors. Only two patients developed superficial wound infection postoperatively, one patient in each group was treated successfully with antibiotics but developed later nail-plate deformity.

Table 2 Clinical and demographic data of patients with tumor recurrence

Patient number	Surgical approach	Age (years)	Sex	Interval before the first surgery (weeks)	Tumor size (mm)	Preoperative bony erosion
1	Modified trapdoor	44	Female	16	2	+
2	Nail nonpreserving	28	Female	8	2	–
3	Nail nonpreserving	36	Male	16	3	+
4	Modified trapdoor	48	Male	18	2	+
6	Nail nonpreserving	64	Male	30	5	–

Revision surgery was performed for the five patients with recurrence. The modified trapdoor technique was used in four patients, while the nail removal technique was used in one patient. Patients with split nail deformity underwent classical split nail repair (Fig. 3).

Discussion

Our study findings demonstrated that the use of either the modified trapdoor approach or complete nail plate removal for excision of the subungual glomus tumor of the nail bed was safe and effective, and associated with less postoperative pain.

Various surgical techniques have been proposed to excise the subungual glomus tumor of the hand. The direct transungual approach by incising the nail bed to reach the tumor offers good surgical exposure to the central subungual tumors, but with a higher incidence of a postoperative longitudinal ridge or complete split nail deformity as it damages the nail bed [1,4,22,23]. In a lateral subperiosteal approach, the tumor is directly accessed but with limited exposure, especially for centrally located tumors [4,24]. Carroll and Berman [25] used a lateral incision close to the edge of the nail to minimize postoperative nail deformation. However, their approach is useful only for tumors that are incompletely under the nail [26]. A high midlateral incision just beneath the lateral nail fold was adopted by Keyser and Littler. The main drawback of this approach is the compromise of the lateral support to the nail matrix and the nail plate due to the retraction of the interosseous structures [4,26]. In the modified periungual approach, an L-shaped incision is planned in the periungual area, and the tumor is excised without splitting the nail bed [27]. However, this approach is limited to peripheral subungual tumors as central tumors could not be adequately exposed [4,22,27]. Our technique differs from the trapdoor procedure of Pahwa *et al*. [28] and Reinders *et al*. [29], where the whole nail plate was avulsed either from distal to proximal or from side to side and then relocated. Although all trapdoor techniques result in significant pain reduction and lower incidence of nail deformation, our modified trapdoor approach offers direct access to the tumor with the advantage of rapid healing and preservation of most of the nail plate.

Kim and colleagues investigated 59 patients with nail bed tumors. They used a transungual approach with complete nail-plate removal in 50 patients and a nail sparing approach in nine patients. Three patients who were operated on using a nail nonsparing approach developed recurrence, while no recurrence was reported in their nail-sparing group. Their results matched our study findings. Our recurrence rate for the modified trapdoor group was 4.5%, and 15% for the complete nail removal group. This observation was within the range of previously reported recurrence rates. Vasisht *et al*. [26] had 15.8%, Kim *et al*. [30] had 6%, Van Geertruyden *et al*. [31] had 4%, Foucher *et al*. [32] had 7%, and Carroll and Berman [25] had 15% recurrence rate.

In literature, early recurrence, within weeks from surgery, indicates an incomplete excision or a presence of a second tumor that was not previously diagnosed and excised during the initial operation, while late recurrence, within years after surgery, might indicate new tumor formation at the same or nearby location [1,25,26,30]. When applying this theory to our patients, only one patient in the modified trapdoor group developed early recurrence within 5 months from the surgery and this indicates incomplete excision, while all other patients with recurrent tumors can be considered as having new lesions. Vasisht *et al*. [26] considered his 3/19 patients with a mean disease-free interval of 2.9 years as having new tumor formation.

Like our findings, no risk factors that significantly predicted recurrence were reported [1,30]. Only the skin-colored tumors are difficult to delineate clearly during the surgery and therefore have a high incidence of incomplete excision and subsequently the chance of recurrence [1,17].

Six patients had nail deformities during our follow-up. Nail-plate preservation is superior in avoiding postoperative nail deformation as the restored nail plate inhibits adhesion of the eponychium to the matrix and acts as a support for the nail bed surface to repair easily. Modified trapdoor patients experienced less pain in the early postoperative period as the nail plate is covering the surgical wound [1,20,30]. When comparing our findings to others, we found similar rates of postoperative

nail deformity. Previously reported rates with subungual approach and complete nail-plate removal varied from 3.3 to 19%. While with nail-plate sparing, the nail deformation ranged from 0 to 11% [16,20,22,30].

Ultrasonography or MRI are recommended for accurate preoperative tumor localization [10,33–35]. Kim and colleagues performed MRI or ultrasonography for 69/72 patients, to get accurate information about tumor location and to confirm the presence of satellite lesions. In contrast, no imaging modality aided in the specific diagnosis of a glomus tumor in the study of Çevik *et al*. [36]. We requested only plain radiography to detect any preoperative bony erosion. Our diagnosis was mainly clinical.

There were some limitations to this study, including the retrospective nature, and the relatively small number of patients because of the strict eligibility criteria and the rarity of the condition. However, the strengths include the application of two different surgical techniques and the use of different outcome measures. In addition, no patients were lost to follow-up.

Conclusions

Both techniques are safe and effective. The modified trapdoor procedure is better reserved for patients with small tumors, while complete nail removal is indicated for those with larger and aggressive tumors, especially in the presence of preoperative nail deformity.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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