LATERAL FOLD ROTATIONAL FLAP TECHNIQUE FOR TREATMENT OF INGROWN NAIL

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ABSTRACT
An ingrown nail is a common disorder that occurs most frequently in the great toe and causes much discomfort in patients. Although many therapeutic methods have been described, most of them can lead to severe damage to the nail, poor cosmetic appearance, or frequent relapses. The treatment of choice for an ingrown toenail has been surgical rather than non-surgical. However, available surgical treatment modalities fail to achieve good esthetic results with low recurrence rates, leaving the toe with a difficult to treat deformity. Our objective in this study is to present a new surgical approach to ingrown toenail treatment based on flap technique to improve the esthetic and functional outcome with low recurrence rate. Twenty patients with 25 affected toes and 34 ingrown toenail margins were operated upon with partial matricectomy followed by lateral fold rotational flap coverage. The patients returned to their normal activity within one week (mean 3.65 ± 1.6 days). The follow up period ranged from 6-12 months (mean 7.8 ± 1.9 months). We had one recurrence in the form of spicule formation in the lateral fold (2.94%). The cosmetic evaluation revealed satisfied patients in 4 cases (20%) and 16 patient evaluated their results as good (80%). In conclusion we believe that the lateral fold rotational flap is a reliable, selective, and esthetically pleasing technique for treatment of all stages of ingrown toenail.

Keywords: Ingrown Nail, Flap, Matricectomy, Nail Surgery, Onychocryptosis, Nail Deformity.

INTRODUCTION
Onychocryptosis (or unguis incarinatus), commonly referred to as ingrown nail is defined as the insertion of the nail plate into periungual tissues and leads to painful swelling, inflammation, infection, and the formation of granulation tissue in the nail walls (1). As a result of this, the lateral edge of the nail plate gets buried by crushing into the granulation tissue formed in the lateral folds, and the ingrowth appearance occurs (2) (Figure 1). Four major types of onychocryptosis can be described in adults: (1) distal nail embedding, (2) pincer nail, (3) juvenile ingrown toenail, (4) and hypertrophy of the lateral nail fold (3). The etiology is multifactorial and often associated (4).

Commonly it is caused by improperly performed nail trimming and repetitive trauma, but there are many risk factors which may be related to foot and toe characteristics to the patient, or related to external factors (5). The first toenail is most often affected because of both its anatomical location and function making it more susceptible to compressive injuries. Other toenails are rarely affected, usually after trauma or infection (6). Finger nails can be affected in infantile type or after trauma (7). According to the signs and symptoms, ingrown nail is classified into 3 stages. In the first stage, the patient has only erythema and swelling along the nail fold. In stage 2, the patient experiences increased pain and there is visible infection, characterized by drainage from the area. Stage 3 is associated with chronic infection, the development of granulation tissue, and soft tissue hypertrophy (8).

Morbidity of ingrown toenail is very significant, as it may interfere with sporting activity, school and work attendance, or daily activities causing much discomfort, pain, and inconvenience (8).

Many therapeutic alternatives for the management of onychocryptosis are available. Although mild cases can be treated conservatively, in severe cases surgical treatment is preferred (5). Surgical procedures may be listed as excision or debridement of the lateral nail groove, incision or debridement of the abscess of the lateral nail fold, partial or total excision of the nail plate, nail fold excision by wedge resection, partial matricectomy followed by lateral fold advancement flap, phenolization of...
the nail matrix, or CO₂ Laser matricectomy (2). Removal of the nail without matricectomy has the highest recurrence rate (64%-83%) (9). Wedge resection is the most commonly performed procedure (10), while phenol chemo-surgical matricectomy has the highest cure rate (93%) (11). A central problem with all these therapeutic modalities is the high rate of recurrence, irregular wound healing period, prolonged discharge, the production of unsightly nail or scar (Figure 2), and the prolonged restriction of normal activities (12).

Although many options are available for the management of ingrown toenail, data on the effectiveness of these techniques is sparse. The effectiveness of management should be assessed based on elimination of symptoms, prevention of recurrence, and preservation of cosmetic appearance of nail after treatment (6).

In this study a new technique is developed in which surgical partial matricectomy followed by lateral nail fold rotational flap is done. The aim is to improve the exposure during partial matricectomy, preserve the nail unit integrity, minimize the recurrence rate, and improve the cosmetic outcome.

**PATIENTS & METHODS**

Between January 2003 and January 2005 we carried out a prospective study of partial surgical matricectomy with lateral fold rotational flap coverage in patients with an ingrown toenail. Consecutive patients arriving at the outpatient clinic of the surgical department in Bny-Suif university hospital and in Kasr Al-Aini hospital with the presentation of ingrown toenail were recruited for the study group. Provided conservative measures had been attempted and failed. The patient accepted surgical intervention after informed consent was obtained. Defined inclusion criteria were toenail symptoms of pain, swelling, discharge, or obvious granulation tissue. Any patients with previous surgical treatment except nail avulsion (Nail folds are preserved) were excluded from the study. The patient was considered cured when self-inspection of the nail showed no subjective evidence of ingrowing of the toenail; there was no discharge; no pain or discomfort from the toe. Recurrence was defined as the presence of symptomatic nail ingrowth within 6 months of treatment (12).

For each patient we record the following: The stage of the disease, the treated toe (Right and/or Left), the treated margin (Medial and/or Lateral), the time elapsed from the day of surgery until normal activity is resumed, the time stitches were removed, development of complications, presence of postoperative swelling (no swelling, mild, moderate, and severe), and development of recurrence.

The cosmetic outcome was evaluated by the patient and the surgeon independently after at least three months from the day of surgery. The result was in the form of: not satisfied, satisfied, or good result.

All operations were performed in the outpatient clinic by one surgeon who performed the follow up. All patients were treated using the same procedure. Photographs in standardized position were taken for each patient preoperatively. The flap was marked and designed according to the extent of the disease.

**Procedure:**

Following preparation of the operation field, the affected toe was anaesthetised with an epinephrine-free solution of 4 ml lidocaine 2%. After waiting for 15 minutes to ensure anesthesia, a surgical glove finger was used for tourniquet application to control bleeding throughout the operation. The first step was to clear any reactive granulation tissue in the vicinity of the nail fold by curettage or simple excision with scissors. A full thickness cut by scalpel No. 15 was carried on through the preplanned lines as follows (Figure 3 and Figure 4):

- A V-shaped area is excised from the proximal nail fold; width depending on the amount to be excised from the nail bed and matrix (3-4mm), while the apex extends proximally for 4-5mm. This V-shaped excision allows for proper exposure and visually confirmed matricectomy. It permits the rotation of the lateral nail fold to cover the exposed area after excision.
- Another incision is carried on the distal end of the lateral nail fold downwards and can be extended over the planter aspect of the toe.
- The whole lateral nail fold is now dissected free and retracted away from the nail bed.
This allows the surgeon to perform excision of the ingrown part of the nail plate and the related matrix from the tip distally to the apex of the V-incision proximally and deep to the periosteum. The amount to be removed ranges between one sixth to one fourth of the nail plate (usually about 3-4mm strip).

- The lateral nail fold flap is rotated upwards to be adjusted to the new size of the nail plate achieving anatomical and esthetic closure.
- Dressing and topical antibiotic were applied after removal of the tourniquet.

Postoperatively are elevation and immobilization recommended for six hours, dressing was changed on the second day.

Postoperative visits were scheduled weekly for one month, and at 3, 6 months and photographs were taken during the follow up. Patients were encouraged to return if they suspected any recurrence of symptoms.

RESULTS

Between January 2003 and January 2005 twenty patients were included in this study, 34 ingrown toenail margins (right lateral: 11 margins, 32.35%; right medial: 11 margins, 32.35%; left lateral: 5 margins, 14.71%; left medial: 7 margins, 20.59%) were treated by partial surgical matricectomy followed by lateral fold rotational flap coverage. In all cases the big toe was the affected toe, with total 25 big toes treated (15 on the right side, and 10 on the left side, counting bilateral toes in 5 patients). The age range of the subjects was 14-31 years (mean 21.65 ± 5.8 years), 15 patients were females and 5 patients were males. None of the subjects suffered from associated diseases as foot ischemia or diabetes mellitus. In eight cases this was the first attack, while in 12 cases they had a previous attack for which they received conservative treatment in 8 cases and simple nail avulsion in 4 cases. The stage of the disease noted at the time of presentation was mild in 9 toes (36%), moderate in 10 toes (40%), and severe in 6 toes (24%) (Table I). All wounds healed and stitches were removed within 8-14 days (mean 11.2 ± 1.4 days), with no instance of postoperative complications as local infection, bleeding, or discharge. Mild inflammation was noticed in 5 cases and was treated by rest and elevation. The patients resumed their daily activity within one week (mean 3.65 ± 1.6 days).

The follow up period ranged from 6-12 months (mean 7.8 ± 1.9 months). During the follow up period we noticed no swelling in 14 treated toes (56%), mild swelling in 9 toes (36%), while moderate swelling affected 2 toes (8%). The swelling resolved completely by the end of the first month by foot elevation overnight in mild cases, while in moderate cases we instructed the patients to rest, elevate the foot overnight, and we prescribed NSAIDs for one week (one of them developed recurrence). We had recurrence in one margin (2.94%) (Table II). This case was a female with bilateral ingrown nail in the right big toe, with severe disease stage. This was her second attack, in the first attack she was treated by nail avulsion. This time the recurrence was in the medial margin after 5 months. During reoperation we found nail spicules in the nail fold and were excised.

The cosmetic evaluation (Table III) was carried on by the fourth month and after. The patient evaluation revealed satisfied patients in 4 cases (20%) with 6 treated margins (the recurrent case included), while 16 patients (80%) with 28 treated margins evaluated their results as being good. The surgeon evaluation was satisfied in 5 cases (25%) with 11 treated margins and good in 15 cases (75%) with 23 treated margins (Figure 5 and Figure 6). There was no dissatisfaction in any case by the patients or surgeon; even in the case of recurrence the end result was satisfying.

<table>
<thead>
<tr>
<th>No of patients</th>
<th>No. of margins treated</th>
<th>No of toes affected</th>
<th>Mean age</th>
<th>Female/male</th>
<th>Disease stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mild</td>
</tr>
<tr>
<td>20</td>
<td>34</td>
<td>25</td>
<td>21.65 ±5.8</td>
<td>15/5</td>
<td>9(36%)</td>
</tr>
</tbody>
</table>

Table I: Characteristics of the patients and disease stage
Table (II): Treatment results

<table>
<thead>
<tr>
<th>Mean Follow up period</th>
<th>Complications</th>
<th>Swelling</th>
<th>Recurrence</th>
<th>Mean time to return to daily activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.8 ± 1.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>infection</td>
<td>no</td>
<td>14 (56%)</td>
<td>mild</td>
<td>One margin (21%)</td>
</tr>
<tr>
<td>bleeding</td>
<td>no</td>
<td>9 (36%)</td>
<td>moderate</td>
<td>3.65 ± 1.6</td>
</tr>
<tr>
<td>discharge</td>
<td>no</td>
<td>2 (8%)</td>
<td>severe</td>
<td></td>
</tr>
<tr>
<td>inflammation</td>
<td>5 mild</td>
<td>no</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>no</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table (III): Cosmetic evaluation results

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Patient</th>
<th>Doctor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Satisfied</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Satisfied</td>
<td>4 cases (20%) with 6 treated margins</td>
<td>5 cases (25%) with 11 treated margins</td>
</tr>
<tr>
<td>Good</td>
<td>16 case (80%) with 28 treated margins</td>
<td>15 cases (75%) with 23 treated margins</td>
</tr>
</tbody>
</table>

Fig. (1): Typical ingrowth appearance in severe Onychocryptosis.

Fig. (2): Unsightly short deformed nail after nail fold excision by wedge resection with loss of nail folds.
Fig. (3): Lateral Fold Rotational Flap procedure, Case 1, Female 16 yrs;
(a) preoperative view with flap design
(b) intraoperative view after flap elevation and partial matricectomy done
(c) after closure of the defect.

Fig. (4): Lateral Fold Rotational Flap procedure, Case 2, Female 28 yrs;
(a) Preoperative view
(b) Intraoperative view after flap elevation and partial matricectomy done
(c) After closure of the defect
Fig. (5): Case 3, Female 24 yrs;
(a) Preoperative view with flap design (b) Intraoperative view after flap elevation
(c) Intraoperative view after partial matricectomy
(d, e) Late postoperative results after 6 months with good result
(f) View showing bilateral big toe with the treated left toe, no big difference between both toes.
DISCUSSION

The ingrown toenail is always induced by the factors of excessive external pressure: tight footwear, improper nail trimming technique, trauma, incurvated nail, etc. (13). Ingrown toenail is a common problem, with 73% of cases occurring in age group 12-30 years. Male to female ratio is 3:1 (8).

Many modalities have been reported to treat ingrown nail with varied results. These therapies can be divided into two categories: the methods of nail matrix destruction and the methods of nail matrix preservation. In general, the nail matrix destruction achieve better results, because the matrix is destroyed permanently thus the lateral nail plate can not grow again to stimulate the lateral nail fold (6).

Several studies advise conservative methods for treating ingrown toenail, especially in cases designed as stage I (8). A conservative approach including treating existing infection, initiating minor interventions (e.g. rest, elevation, wound soaks, avoidance of tight footwear), proper trimming to allow the corner of the nail to project beyond the edge of the skin, and massage of the nail fold (14). This approach may be satisfying for some patients with mild stage I disease. However, these methods are inconvenient, result in both poor cosmetic appearance and possible toe injury by pulling the protruding distal nail plate upwards accidentally. Moreover, they are not helpful for advanced stages (6).

The avulsion of the nail plate is only helpful for immediate relief of pain and secondary infection, but the recurrence rate is very high and ranges from 64-70% (9). Also, during re-growth of the nail plate, the unsupported distal soft tissue is bulging by upward forces disturbing the growing nail and ending by a deformed short nail (15).

The nail matrix phenolization has been used in the treatment of ingrown nail since 1945. Many refinements and modifications have been tried with cure rate ranging from 0.13% to 50% (10). Despite high cure rate, the liquid phenol may spread after application and damage surrounding tissue. Though very rare serious systemic complications with phenol have been
reported (8). This method still require some adjuvant treatment; such as electrocautery when the ingrown nail is associated with nail fold hyperplasia or granulation tissue formation (6). The evidence suggests that the addition of phenol dramatically decreases symptomatic recurrence, but at the expense of increased postoperative infection (16).

Laser surgery of the nail apparatus has become real with the introduction of CO₂ lasers more than 20 years ago. The modified technique of nail surgery with laser-assisted nail plate avulsion caused less postoperative swelling and pain with low recurrence rates (17). Disadvantages were higher cost, prolonged wound healing, a small ill-looking nail and cuticle (6). Surgical procedures, including the lateral nail fold excision (18), Winograd procedure (19), and Zadiks’ procedure (20) can achieve high cure rates. However, the disadvantages are prolonged time of wound healing, more complicated procedures, and the poor cosmetic appearance of the nail postoperatively (6).

During surgery for ingrown toenail, it is considered important to selectively, completely, and reliably destroy the affected nail matrix (21). The best treatment should meet the following requirements: effective; simple; cheap; outpatient procedure with little postoperative discomfort and quick return to normal activity; low rate of recurrence; and lastly cosmetically good outcome (22).

Reconstruction with flaps has been described in two previous studies only. Ney in 1923, described an operation based on two skin flaps of the entire surface on the affected side of the toe, then all the subcutaneous tissue perpendicular to the nail margin was removed (23). This procedure was too complicated with high possibility of flap sloughing (2). The second technique has been proposed by Harun et.al. They described partial matricectomy followed by lateral fold advancement flap with good cosmetic results, 8.1% recurrence rate, and 5.2% spicule formation rate (2). We believe that this flap technique has met many of the criteria, as they preserved the nail unit integrity and respected the cosmetic value. It still has some disadvantages as: possible step deformity of the nail fold at the site of advancement flap, improper exposure of the nail matrix especially at the proximal nail fold, dog-ears and the need to sacrifice normal skin to correct it with possibility to impair the blood supply of the flap, ending by two scars at pressure points.

In this study, satisfactory results have been achieved both a low recurrence rate (2.94%) in the form of a spicule formation (which is not considered as a recurrence by many authors) and good cosmetic results with high rate of satisfaction in both patients and doctor assessment. This new technique is an easy procedure with reproducible results, and a non-complicated simple rotational flap that offers a perfect wide exposure to the whole margin of the nail unit to be effectively and completely treated. The preservation of the nail fold and the integrity of the nail unit achieved in this technique are of utmost importance in the ability of two-point discrimination, the protection of distal phalanx, and the cosmetic appearance. All these have been achieved with rapid return to daily activities and short wound healing time. Conclusively, the lateral fold rotational flap procedure presented in the study is a selective, reliable, and esthetically pleasing technique for all stages of ingrown toenail treatment.

REFERENCES

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