The management of ingrown toenails with soft tissue/periungual resection without nail resection or matricectomy: A scoping review.

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**Background:** Most authors cite that an ingrown toenail is caused by an ingress of the nail plate into the perungual soft tissues, though a minority of authors believe that soft tissue pathology is primarily responsible. Consequently, when nail surgery is indicated, there is a dichotomy in the treatment approach aimed at either nail/nail matrix resection or soft tissue debridement.  

**Aim:** The aim of this research is to collate, code and chart data regarding ingrown toenails managed with soft tissue procedures - without nail or nail matrix resection.  

**Methods:** A scoping review of the literature on soft tissue resection techniques for the management of ingrown toenails without nail or nail matrix resection was carried out using current scoping review practice and PRISMA-ScR guidelines.  

**Results:** 25 articles were included in the review. Most of these papers were case studies or case series. Multiple surgical techniques were found but with no clear best technique identified due to low-quality research using heterogeneous methodologies.  

**Conclusions:** The evidence for the soft tissue management of ingrown nails is lacking in quality but warrants further consideration. High quality, perspective studies need to be performed to be eligible for future Cochrane reviews.  

**Keywords:** ingrown toenail, onychocryptosis, nail surgery, periungual, soft tissue

The ingrown/ingrowing toenail (IGTN) is one of the most common foot problems in the general population [1,2]. The hallux is most commonly involved but it may also involve the lesser toes, especially after trauma [3,4]. The latest Cochrane Review states that the condition occurs when poor nail care causes the nail plate to puncture the sulcus, and this has long been the perceived wisdom [2]. However, a minority of authors contend that it is the soft tissue pushing on the nail plate that is at fault and causing the penetration [5]. The skin attempts to heal when punctured but with continued irritation from the nail plate the excess healing leads to the formation of hypergranulation tissue [6]. Hanke states that there are two fundamentally different approaches in the literature for the surgical management of IGTN [7]; by those authors in the majority view that consider a wide nail plate in relation to a narrow nail bed is at fault and seek to address the nail width in some manner, or by those authors believing that the soft tissue is primarily at fault who propose to remove the soft tissue so that there remains no substrate for the nail to grow in. Much less attention is given to the soft tissue management of this condition in the literature - the focus has largely been on the nail penetrating the soft tissue and dealing with the nail matrix (rather than the soft tissue). Various soft procedures - without removal of nail or nail matrix - are reported but they have gained little traction over nail-based procedures [7,8]. Figures 1 and 2 are the work of the senior author (IR) and show what can be effectively achieved with simple soft tissue resection without nail/matrix resection. The aim of this scoping review is to identify the relevant literature for soft tissue procedures without nail/nail matrix resection and make recommendations for future research.
An a priori protocol should be developed before undertaking the scoping review [12]; this is available online [13]. Pollock, at al., [14] recommended registration of scoping review protocols: this can be found at Open Science Framework [15].

Rigour of process

A methodological framework for scoping reviews was proposed by Arksey and O’Malley, which was developed and amended by Levac, et al. [16]. This review followed their six-step process, minus the consultation stage, which is considered optional [10,12]. In 2018, the Preferred Reporting Items for Systematic Reviews (PRISMA) Statement was extended to include Scoping Reviews – PRISMA-ScR; this study incorporated that process [17].

Aim

The research aim was to determine what evidence is available regarding IGTNs surgically managed with soft tissue/periungual resection without nail or nail matrix resection, and to map or chart the data obtained to identify themes. This will then provide a research agenda for future studies to be developed.

Objectives

Stage 1: Identifying the research question

Scoping study research questions are broad in nature as the focus is on summarising the breadth of evidence. Clarity of the review question assists in developing the protocol, facilitates effectiveness in the literature search, and provides a clear structure for the development of the scoping review. The Joanna Briggs Institute (JBI) recommends the Population–Concept–Context (PCC) framework [12].

Stage 2: identifying relevant studies

To achieve the objective, a search strategy was adopted that involved searching for research evidence via different sources:

1. Electronic databases
2. Google Scholar
3. Reference lists
Studies which

the original
matrix

Exclusion criteria

Context:

Concept:

Population:

Inclusion criteria

language searches [12].

Peters, excluded
identified
retrieved
and
After the search
strategy, execution
the
search

Step 2: Google Scholar was searched using key words identified from an analysis of the title and abstract of retrieved papers, and these keywords used to search for articles,

Step 3: The reference lists of all identified sources from steps 1 and 2 were examined.

Stage 3: Study selection

After the execution of the search strategy, the identified records were retrieved and included or excluded using the PCC format as recommended by Peters, et al., who recommend not limiting by date or language searches [12].

Inclusion criteria

Population: human subjects (patients) with an IGTN,

Concept: articles with specific focus on soft tissue resection or plastic (skin) repair without nail or nail matrix resection,

Context: the review will include all stages of IGTN and study designs and book chapters; there are no date or language restrictions.

Exclusion criteria

Studies that combined soft tissue resection with orthonyxia (bracing), matricectomy, or any other nail or matrix ablation or bone resection methodology,

Studies for which the original manuscript could not be retrieved.

Studies using a combination of soft tissue and nail/matrix techniques.

Stage 4: Charting the data

The data was charted according to the criteria outlined by Peters, et al., adapted for this review[12].

Stage 5: Collating, summarising, and reporting the results

The papers were coded to present a narrative account of the existing literature. All the codes identified were charted in tables to provide focus and clarity for developing provisional themes.

Ethical considerations

This project will therefore also seek to utilise and balance virtue and principle based ethical approaches. The goal is to produce a piece of work, built on a strong scientific base, that credibly adds to the evidence base for the study of nail pathology.

Results

A database search via the NHS Healthcare Advanced Database Search (HDAS) yielded 5692 articles, 123 of which appeared to be of potential relevance. After removing 36 duplicate articles, this total was reduced to 87. After reviewing the title and abstract, 71 were found to be irrelevant, leaving 16 articles which were retrieved as full texts. 43 further articles were found through Google Scholar and reference lists to give 59 articles for review. After retrieval, 16 articles were excluded as not directed to the soft tissue resection alone, 15 articles were unobtainable and 3 were not in English, leaving 25 articles for data extraction (see Figure 3 for the PRISMA flowchart).

Iterative charting of the included articles yielded overlapping codes and repetition of techniques. These were focused as themes:

- Resection of skin and/or ingrown toenail
- The aggressiveness of the resection (mild, moderate, or radical)
- Closure: by primary (sutures) +/- skin flap or by secondary intention (open)
- Profession by origin of study – general surgery/dermatology predominate
- Profession by geographical base
The differentiation between radical (Figure 4) and semi-radical is somewhat arbitrary as techniques blend into each other and overlap to a greater or lesser degree. The techniques themselves come from a range of medical professions - with general surgery (in older texts) and dermatology predominating; the systematic review from de Brule, being the only one coming from podiatry [8]. There is also a strong international field to the evidence base (see Table 1). As noted by deBrule in his study, case studies and case series predominate [8].

**Discussion**

This scoping review has identified what the evidence base contains for the use of soft tissue/periungual resection procedures without nail resection or matricectomy in the management of IGTN pathology. A search strategy was developed and executed; 25 articles were available for data extraction. Iterative charting of the included articles yielded overlapping codes and repetition of techniques, leading to a focused dataset.

Most papers identified in this review are case studies, brief historical notes or case series but given the low quality of the case series presented, it is difficult to make firm recommendations on the relative merits of such procedures.

Few authors declared if they had received any funding to support the publication of the papers and most papers were published in low impact journals or were historic pieces whose format pre-dated the standard scientific notation for scholarly articles. There was often little or no discussion whether or how the findings articles compare to nail avulsion and/or matricectomy techniques, and limited thought over methodological design. Many papers had a small or modest cohort size, limited follow-up and general lack of randomization of control. For example, the work of Chapeskie and Kovac [25], is biased by their argument that phenol techniques have poor cosmetic results, high rates of recurrence and low patient satisfaction, which is contrary to the Cochrane review [2], which found the opposite. The two Chapeskie (junior) papers [24,25] are expert opinion pieces only and build on equally poor methodological work from Vandenbos and Bowers [5]. These articles have limited referencing and no discussion of bias or ethical considerations.

de Brule identified ten distinct operative techniques in his systematic review but techniques such as the super U were omitted [8]. de Brule’s key finding was the deficiency of randomized controlled studies, and he stated that without high-level studies, nail fold resection may have difficulty gaining acceptance: he cites the limited two-paragraph discussion in the 2012 Cochrane review given to this area [2]. Usefully, he suggests that for future studies they be sufficiently powered, multicenter, and have a sufficiently long follow-up of at least a year to allow for delayed recurrence of IGTN.
Furthermore, de Brule posits that such studies should include a universally accepted classification system for the staging of the IGTN presentation together with healing times, post-operative pain levels and patient satisfaction.

Di Chiacchio and Di Chiacchio [30] state that the Howard-Dubois and super U techniques are indicated when ingrown nails are caused by hypertrophy of nail folds, according to the degree of severity, with the super U recommended where greater soft tissue resection is required. Pearson et al questioned the association of nail plate abnormality and the IGTN in their prospective study [41]. 23 consecutive patients and 23 age-matched controls were assessed by calliper measurement and standard photographs, before a first operation for IGTN. They found no differences in shape between the toenails of the IGTN patients and those of the controls, both groups showing great variation, suggesting that the ingrowth is not associated with an abnormal nail plate shape.

Murray noted that soft tissue procedures were not widely employed or evidenced at that time but stated that their general aim was to remove the soft tissues on which the nail plate was impinging[42]. He references historical papers by Ney, Brealey and Dubois and hypotheses that such procedures might find a place in the surgical management of IGTN, filling a gap between simple nail plate avulsion and nail ablation techniques [37, 43, 44]. Antrum [19] also noted the lack of popularity of soft tissue techniques with this concept being promulgated by Chapeskie (senior) over several years. For treatment of a chronic IGTN with hypertrophic lateral walls, Richert [45] suggests:

1. The Vandenbos procedure
2. Noël's procedure
3. The super U
4. The Howard-Dubois

Noting that these techniques are variants of each other, Richert’s key point is the importance of removing enough soft tissue to avoid recurrences. The following year Richert wrote further on the surgical management of IGTNs, championing the chemical matricectomy but also promoting the use of

<table>
<thead>
<tr>
<th>Primary Author/Year</th>
<th>Country*</th>
<th>Profession/Dept.</th>
<th>Level</th>
<th>Excision Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alptekin, 2011[18]</td>
<td>Turkey</td>
<td>Surgery/ER</td>
<td>IV</td>
<td>Triangular</td>
</tr>
<tr>
<td>Breton, 1980[21]</td>
<td>UK</td>
<td>Pediatric Surgery</td>
<td>IV</td>
<td>Semi-radical, nail sulcus ++</td>
</tr>
<tr>
<td>Browne, 1894[22]</td>
<td>UK</td>
<td>General Surgery</td>
<td>V</td>
<td>Radical – Vandenbos</td>
</tr>
<tr>
<td>Chapeski, 1998[23]</td>
<td>Canada</td>
<td>Family Practitioner</td>
<td>IV</td>
<td>Radical – Vandenbos</td>
</tr>
<tr>
<td>Cordova, 2008[26]</td>
<td>Brazil</td>
<td>Dermatology</td>
<td>IV</td>
<td>Howard-Dubois</td>
</tr>
<tr>
<td>Correa, 2017[27]</td>
<td>Uruguay</td>
<td>Dermatology</td>
<td>IV</td>
<td>Super U</td>
</tr>
<tr>
<td>Cotting, 1872[28]</td>
<td>USA</td>
<td>General Surgery</td>
<td>IV</td>
<td>Radical – Vandenbos</td>
</tr>
<tr>
<td>Cotting, 1893[29]</td>
<td>USA</td>
<td>General Surgery</td>
<td>IV</td>
<td>Radical – Vandenbos</td>
</tr>
<tr>
<td>de Brule, 2015[30]</td>
<td>USA</td>
<td>Podiatry</td>
<td>III</td>
<td>Various</td>
</tr>
<tr>
<td>Di Chiacchio[30]</td>
<td>Brazil</td>
<td>Dermatology</td>
<td>IV</td>
<td>Howard-Dubois/Super U</td>
</tr>
<tr>
<td>Gualdi, 2014[31]</td>
<td>Italy</td>
<td>Dermatology</td>
<td>IV</td>
<td>Elliptical – plantar (Monaldi)</td>
</tr>
<tr>
<td>Kulidakis, 1981[33]</td>
<td>USA</td>
<td>General Surgery</td>
<td>IV</td>
<td>Elliptical</td>
</tr>
<tr>
<td>Livingston, 2017[34]</td>
<td>Canada</td>
<td>Pediatric Surgery</td>
<td>III</td>
<td>Radical – Vandenbos</td>
</tr>
<tr>
<td>Mohammad, 2018[35]</td>
<td>Egypt</td>
<td>General Surgery</td>
<td>IV</td>
<td>Semi-radical, nail sulcus</td>
</tr>
<tr>
<td>Ney, 1923[37]</td>
<td>USA</td>
<td>General Surgery</td>
<td>IV</td>
<td>Hemispherical – flap</td>
</tr>
<tr>
<td>Noël, 2008[38]</td>
<td>Switzerland</td>
<td>Dermatology</td>
<td>IV</td>
<td>Semi-radical, nail sulcus +</td>
</tr>
<tr>
<td>Rosa, 2015[39]</td>
<td>Brazil</td>
<td>Dermatology</td>
<td>IV</td>
<td>Super U</td>
</tr>
<tr>
<td>Tweedie, 1985[40]</td>
<td>UK</td>
<td>General Surgery</td>
<td>IV</td>
<td>Hemispherical – flap</td>
</tr>
</tbody>
</table>

Table 1 Data extraction (*country of the lead researcher rather than the country of the journal where published.

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periungual resection, suggesting that each type of IGTN may benefit from a specific treatment[46]. Some nails may benefit from a traditional chemical matricectomy approach but with simple secondary avulsion of extra tissue; others may be better indicated for a primary soft tissue excision but adds that different procedures may be performed on the same IGTN to obtain good results. He suggests that there is no “cure-all” technique for IGTNs, but mainly two different approaches (narrowing the plate or debulking of soft tissues), and that both are excellent, if they are performed well, in appropriate cases.

The literature search revealed a large number and range of procedures that have been proposed over 150 years though some references are a replication of an early technique, where one assumes that the latter author was unaware of an original piece of work. The authors of this paper have identified that the radical excision known as the Vandenbos technique had already been described by Cotting and Stillwell [5, 22, 28]. Hanke also notes that many published procedures are just minor variations of old surgical techniques that infrequently bring any progress and admonishes authors who show they do not understand the etiology and pathogenesis of IGTNs [7]. Richert notes that phenolic nail techniques are the most popular option employed by dermatologists [46]. This is typically the only operation performed by UK podiatrists; not including UK podiatric surgeons who do perform incisional techniques [47-49]. Although the authors of this paper have been able to identify key themes running throughout the 25 papers, inconsistencies appear after examining each paper in detail. Disappointingly, most of the articles charted in this review were level IV/V case studies or case series. That said, the implication is that the more aggressive the soft tissue resection, the better the long-term result. However, aggressive resection to be balanced against an increased risk of scarring, wound healing, necrosis, and denervation of the digit. A striking characteristic in many papers is that they made overgeneralizations and presumptions from the data obtained. In trying to put forward better ways to manage the problem of the IGTN, it seems reasonable to suggest a nuanced approach, using a combination of soft tissue and nail resection, depending on the presentation of the nail, with the aim of giving the best outcome for the patient, based on the patient’s treatment goals.

While the article from Dubois was retrieved, it was only available in the original French language [44]. The original article from Rosa, et al., was only available in Portuguese and the paper by Kassirow (a Howard-Dubois clone) was in Russian [50, 51]. Of the many unobtainable articles, the article by DuVries is described by Dockery as “taking a large segment of tissue from the side of the toe with two semi-elliptical incisions closed with suture … designed to relieve all the soft tissue pressure from the toenail margin”[52, 53]. The authors are aware that papers may have been completely missed due to inaccurate abstracts or misleading titles. For example, it would be easy for the researcher to overlook a paper titled “management of IGTNs” that included useful and relevant data for this review, but which would not be clear from the wording. It is logical to assume this is the main reason so many articles were missed from the primary data trawl, and the high number of useful papers that was found through Google Scholar and snowball referencing. The search strategy could have been more thorough and complete by using the words “soft tissue”, “management” and “ablation”. A further criticism of this study is that the exclusion criteria ruled out papers where soft tissue excision was done in combination with nail or nail matrix resection. For example, Robb and Murray performed a Howard-Dubois shaped resection with nail avulsion. The research protocol will now be repeated to include combination techniques[42].

Conclusion

This review has generated a wide sample of published work, coming from a range of medical disciplines and from an international base. Themes emerged over the amount and location of skin and/or HGT resection, if the wound healed by primary or secondary intention, and over the location and profession of the lead authors. A qualitative methodology was selected over a quantitative systematic review because there was no homogeneity of the data, and the level of the research papers was poor. Though lacking in quality, the evidence for the soft tissue management of IGTNs warrants further consideration.

While there is no clear best technique from the available literature, the underlying implication is that the more aggressive the soft tissue resection, the better the overall outcome. The main implication for future research is to challenge the podiatric and medical communities to perform prospective,
high-quality randomized controlled trials using soft tissue resection for the management of IGTNs. This should include differentiation of techniques using a combination of nail and/or nail matrix resection where soft tissue resection is the key element of the procedure and compare that to what is considered the current gold standard of chemical matricectomy. Such research should be of sufficient rigour to be available for future Cochrane reviews.

References


