

R E V I E W

On the dissection of fibrotic hypodermic connective tissue in aesthetic and plastic surgery

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Abstract. Background: There are many procedures that refer to the dissection of fibrotic connective tissue in the hypodermis: subcision, needle aponeurotomy, percutaneous needle fasciotomy, and Rigottomy. The only aspect that differentiates all these procedures appears to be their therapeutic target. **Aim:** This systematic review aims to determine whether the aforementioned techniques are different, or if there is redundant terminology, by highlighting differences, similarities, and overlaps between the techniques. **Methods:** A systematic literature search was conducted using the PubMed database for relevant studies published up to August 2022. **Results:** Of the 384 articles identified through the literary research, 263 met the eligibility criteria. 46.77% of these came from searching the term “subcision” and referred mainly to aesthetic treatments, such as reducing the visual stigma of scars and improving the appearance of cellulite. 47.53% of the articles referred to the reduction of hand contractures, mainly related to Dupuytren’s disease. The various procedures refer to different applications, but the biological effect they cause are similar. **Conclusions:** The review provided relevance to the presence of many terms that indicate similar procedures and have similar biological effects, but all refer to fibrotic hypodermic connective tissue dissection. However, the fields of application are different and the clinical results described in the literature suggest the need of an elaborate dialogue between different specialists.

Key words: subcision, aponeurotomy, fibrotic connective septa, cellulite, Dupuytren disease

Introduction

In the medical-surgical field, it is interesting to note that sometimes very similar procedures are identified using different terms. This is a relevant problem because the knowledge linked to a consolidated practice, in terms of post-operative, clinical, and biological effects, is not extended to other procedures, which therefore go through an entire, sometimes complex, optimization process without exploiting the already acquired know-how. This can be applied to the dissection of fibrotic hypodermic connective tissue, a practice widely used in both aesthetic plastic surgery and beyond.

An example of a connective tissue dissection technique is the minimally invasive surgical technique

of subcision. Introduced in 1995 for the treatment of wrinkles and scars, but also recommended for dimpled cellulite¹, it has characteristics very similar to Rigottomy², needle aponeurotomy³, and percutaneous needle fasciotomy⁴. The main difference between these procedures seems to be their therapeutic targets. The principle of resolving a contractile state to promote full functional recovery, taking advantage of natural healing and regeneration, appears to be the same.

This systematic review aims to answer a fundamental question: “Are these different techniques, or is it redundant terminology?” The differences, similarities, and overlaps between the aforementioned different clinical/surgical techniques were highlighted to reply to this question.

Materials and methods

A systematic literature search was undertaken in PubMed (United States National Library of Medicine, Bethesda, MD) of all the articles published up to August 2022. Given the purpose of the study, which was to understand how, and in what context different terms were used to designate the same or similar procedures, highlighting analogies and differences, it was not considered necessary to utilize multiple databases for research. Furthermore, the cited/citing references of the individual articles identified were not analyzed. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses literature search extension (PRISMA-S) guidelines were used⁵.

Search terms

The search terms were: “subcision”, “needle aponeurotomy”, “percutaneous needle fasciotomy”, “percutaneous fasciotomy”, “fasciotome”, “Rigottomy”, “Rigotomy”, “Sting technique”. The only ineligibility criterion was that the studies were not written in English. Eligibility criteria were: studies for which full text was available, and studies in which treatments were performed with needles and/or cannulae.

Data analysis

The search terms corresponded to the different clinical techniques under study. For each one, the number of works was counted, and the clinical and therapeutic scope of the application was verified. The operative procedure was analyzed to highlight practical differences as well as the depth of action in the tissues. It was also checked whether the technique was applied alone or in combination with other procedures.

Results

Search results

Pubmed research identified 384 articles. After the removal of 13 duplicates, another 12 articles were discarded according to the ineligibility criterion (Articles

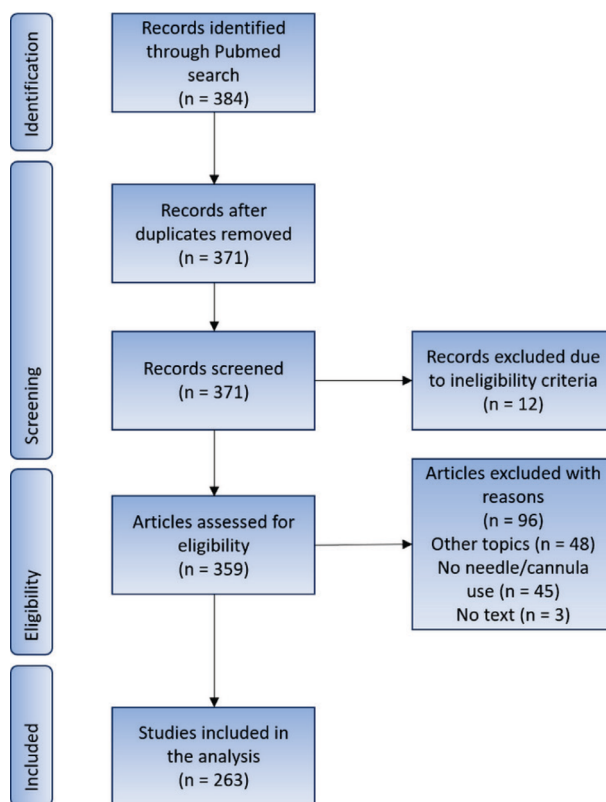


Figure 1. PRISMA flow diagram.

in: German - 4; French - 3; Spanish, Dutch, Czech, Russian, Portuguese - 1). Of the remaining 359 articles, 96 did not meet the eligibility criteria and were excluded from the analysis. 263 articles were identified as suitable for the aims of the present review. The PRISMA flowchart describes the research process in detail (Figure 1).

Characteristics of the included studies

The search for the term “subcision” is the one that produced the highest number of results (46.77% of the total articles). Summing up the articles obtained from the searches of the strings “needle aponeurotomy” (28.52% of the total articles), and “percutaneous needle fasciotomy” (18.63% of the total articles) we obtain 93.92% of the 263 articles identified. The results of the individual searches are summarized in Table 1.

47.53% of the articles concerned hand surgeries, 30.42% concerned treatments to reduce the visual

Table 1. Search results for individual terms.

Searches	Results	Duplicates		No English		Others contents	Eligible articles
Subcision	164		164	1	163	40	123
Needle aponeurotomy	89		89	3	86	11	75
Percutaneous needle fasciotomy	82	6	76	3	73	24	49
Percutaneous fasciotomy	25	4	21	1	20	16	4
Fasciotome	14	1	13	4	9	5	4
Rigotomy/Rigotomy	8	1	7		7		7
Sting technique	2	1	1		1		1

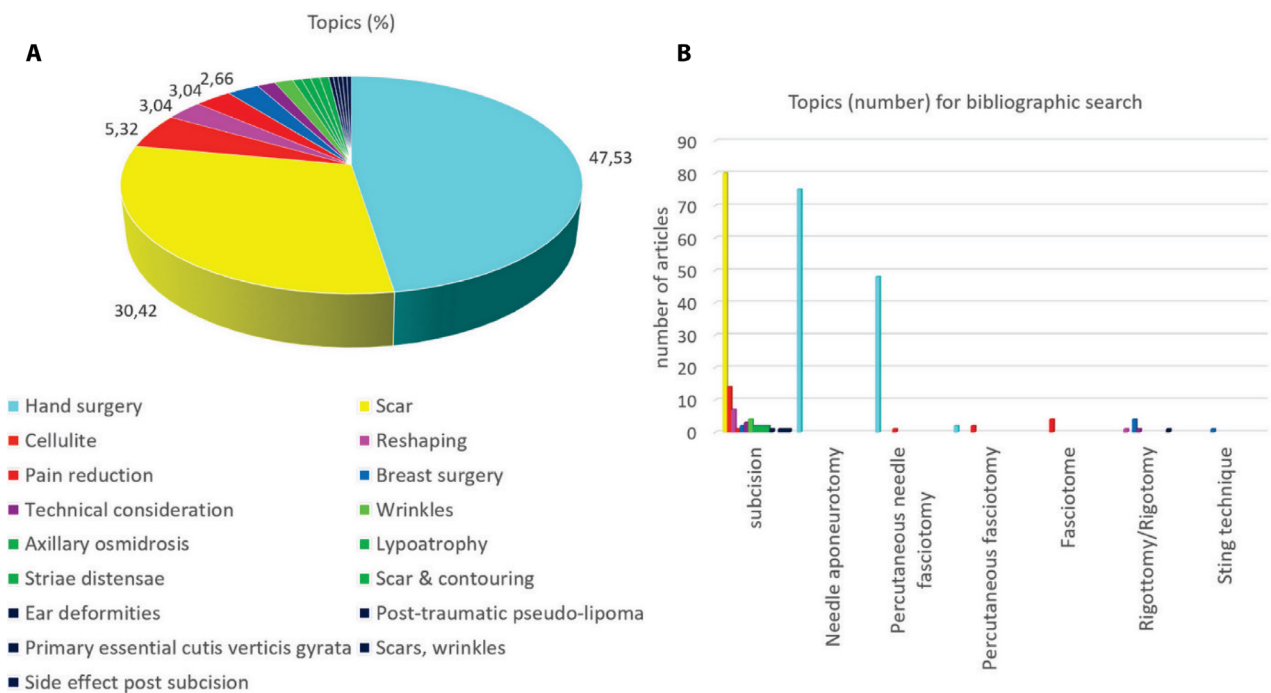


Figure 2. A. General fields of application of all the procedures sought. B. Fields of application relating to the individual terms searched.

stigma of scars and restore some functionalities, and 5.32% concerned the aesthetic improvement of dimpled cellulite (Figure 2A). The first articles were all identified by searches performed with the strings “needle aponeurotomy” and “percutaneous needle fasciotomy”. The articles concerning the treatment of scars and cellulite were, on the other hand, derived from the search for the term “subcision” (Figure 2B).

All but one of the articles related to hand surgeries referred to Dupuytren’s disease. 80% of the articles

on scars referred to atrophic acne scars. Seventy-three out of eighty articles (91.25%) described scars on the face (Table 2).

All the articles face the problem of the presence of fibrotic connective tissue in the hypodermis. This tissue alters the overlying structures, inducing aesthetic impairments, regulating pathological conditions, and pain. In all of the procedures considered, the fibrotic septae were cut with needles, or small diameter canulas. All of these procedures generally work in the

Table 2. Characterization of articles related to scars.

Scars	Number of articles	Type of articles	Anatomical site
Acne scar	64	<ul style="list-style-type: none"> • clinical application (43) • review (15) • letters/comments (3) • operative procedures (3) 	face (64)
Depressed facial scar	3	<ul style="list-style-type: none"> • clinical application (3) 	face (3)
Surgical & depressed/atrophic scar	3	<ul style="list-style-type: none"> • clinical application (2) • review (1) 	face (3)
Burn scar	2	<ul style="list-style-type: none"> • clinical application (2) 	head & neck (1) multiple anatomical sites (1)
Facial scar	2	<ul style="list-style-type: none"> • review (1) • letters/comments (1) 	face (2)
Scar revision	2	<ul style="list-style-type: none"> • clinical application (1) • review (1) 	knee and nose (1 – clinical application) multiple anatomical sites (1 – review)
Atrophic acne & depressed scars	1	<ul style="list-style-type: none"> • clinical application (1) 	face (1)
Atrophic scar	1	<ul style="list-style-type: none"> • operative procedures (1) 	face (1)
Nasal depressed scar	1	<ul style="list-style-type: none"> • clinical application (1) 	face (1)
Varicella-Zoster scar	1	<ul style="list-style-type: none"> • review (1) 	face (1)

deepest part of the superficial hypodermis, above the superficial fascia. Six articles⁶⁻¹¹ referred to deep painful states (myofascial pain⁶, fibromyalgia syndrome⁶, chronic exertional compartment syndrome⁷⁻¹¹), for which the action of the treatments was deepened up to the collagenous layers of the epimysium. In this last field of application, in four procedures an incision of at least 2 cm was required for the insertion of the instrument^{7,9-11}.

Excluding literature reviews, which described multiple treatments or multiple treatment modalities, the searched procedures were found to be applied alone in 99 of 187 articles (52.94%), while they were used in conjunction with other techniques or products in 56 articles (29.95%). Thirty-two articles (17.11%) compared different procedures or the effectiveness of different tools for a given procedure.

As for the side effects associated with the use of these procedures and the resulting costs/benefits, only 20 out of 263 articles (7.6%) reported them. The data from these articles is summarized in Table 3¹²⁻³¹. All of these articles refer to the procedure performed on Dupuytren's disease¹⁴⁻³¹, except for two articles concerning the subcision of a scar¹², and the subcision of cellulite¹³.

Discussion

As seen from this bibliographic research, the terms “subcision”, “needle aponeurotomy”, and “percutaneous needle fasciotomy” emerge when referring to the resolution of subcutaneous fibrotic layers through the use of needles or similar instruments such as cannulae. The term subcision is the most common and refers to an application in a greater number of contractile situations than the other terms (Table 1, Figure 2B). Although the term “needle fasciotomy” has been used longer³² than the term “needle aponeurotomy”³³, more articles have been identified with the search for the latter (Table 1). This may be due to the fact that the term “fasciotomy” generically refers to a cut in the fascia, but in the procedures described, it is evident that there is no involvement of the superficial fascia. Those that are “cut” are collagen fibers with an orthogonal or oblique course with respect to the skin surface, and which from the fascia cross the superficial hypodermis and enter the dermis. The term “Rigotomy” (sometimes cited as “Rigotomy”) is the only one patented, but it is less used in the literature than the previous terms.

Table 3. Characterization of articles reporting complications and cost/benefit analyses.

Procedure	Side effects (number of articles)	Costs/benefits (number of articles)	References
Subcision	2	-	Reolão et al. ¹² Hessel and Mazzuco ¹³
Percutaneous aponeurotomy	1	7	- <u>side effects</u> : Russell ¹⁴ - <u>costs/benefits</u> : Leafblad et al. ¹⁵ Elzinga and Morhart ¹⁶ Maravic and Beaudreuil ¹⁷ Baltzer and Binhammer ¹⁸ Herrera et al. ¹⁹ Wiwanitkit ²⁰ Chen et al. ²¹
Percutaneous needle fasciotomy	8	2	- <u>side effects</u> : Mensa et al. ²² Turner et al. ²³ Therkelsen et al. ²⁴ Moog et al. ²⁵ Reid et al. ²⁶ Jones et al. ²⁷ Krefter et al. ²⁸ Symes and Stothard ²⁹ - <u>costs/benefits</u> : Dritsaki et al. ³⁰ Mansha et al. ³¹

Interestingly, the terms sought are used in almost exclusive fields. While the term “subcision” is used more for aesthetic applications (Figure 2B), the terms “needle aponeurotomy”, “percutaneous needle fasciotomy”, and “percutaneous fasciotomy” refer almost exclusively to the resolution of the contractile states of Dupuytren’s disease. The “fasciotome” is an instrument that is mainly used in the orthopaedic surgery of the legs⁷⁻¹⁰. “Rigotomy/Rigotomy” is a procedure used in several fields³⁴⁻³⁸, but it seems to refer more to breast surgery, where the term was introduced^{2,39}.

Despite the great difference in the fields of application of the procedures sought, the tissue involved in the treatments was always the same, i.e. the connective component of the superficial hypodermis. It is known that the hypodermis differs in various parts of the body⁴⁰, probably due to the numerous functions it performs in various parts of the body. However, in the superficial part of the hypodermis, it seems that the connective tissue present is more easily subject to

altered situations, with the formation of fibrotic components often painful compared to the deeper connective tissue.

A very interesting fact that emerges from the bibliographic research is that, in 24.95% of the articles, the procedures are associated with other treatments and/or the use of other tools. This finding is likely related to the attempt to optimize clinical outcomes. This is especially true of subcision, which is the procedure most associated with other techniques. The results obtained using subcision, alone or in combination with other techniques to reduce the stigmatization of scars, are generally good but not excellent, and several studies have reported different results, as highlighted in the review by Dadkhahfar et al.⁴¹ The same can be said for cellulite, for which the subcision technique is indicated as the one with the most lasting, but not definitive, effects⁴². The collagenous septa that determine the orange peel appearance of cellulite tend to reform over time, underlining how, in this case, the subcision

allows excellent temporary aesthetic results but does not affect the mechanisms that cause cellulite. In Dupuytren's disease, "needle aponeurotomy", "percutaneous needle fasciotomy", and "percutaneous fasciotomy" are mainly used alone. However, in this case, the number of reported complications is greater. And the number of articles analyzing the cost/benefit ratio of treatment is much higher than the number of the same articles published for other procedures (Table 3). It is necessary to specify that the definition of complications in the various application areas must be carefully considered. For example, the treatment of cellulite with subcision can cause bruising, persistent erythema, pain, and hemosiderosis, all of which can last for months¹³. However, these are considered minor and acceptable complications compared to the aesthetic effects that are generally achieved. Hand complications, obtainable, albeit in low percentages, with Dupuytren's disease procedures, can lead to the persistence of a functional alteration²⁴. Despite this, it is curious to note that no combinations of techniques are implemented to try to reduce these unwanted effects. In fact, there are a limited number of studies in which treatments are associated with steroid injections⁴³, collagenase injections⁴⁴, or lipofilling^{16,45}. Perhaps this is due to the fact that the results obtained using the combined techniques are not particularly different from those obtained without these additional interventions⁴⁶.

It is important to underline an aspect that is seemingly quite generic given that it is applied to all the sought-out procedures, which is that they act on the adipose tissue, and that the areas they treat have different quantities of this tissue. From the bibliographic research performed, it seems that in the areas where there is more fat tissue, the procedures cause fewer and/or less serious side effects. This is probably due to the regenerative properties of the adipose tissue^{39,47-50}, properties that could favour the healing process after the application of the procedures. The presence of a great layer of adipose tissue can favour the effectiveness of treatments for facial scars, mainly from acne localized on the cheeks, cellulite on the hips and buttocks, and breast interventions such as augmentation and correction of malformations. When significant breast bulking is required, such as in the case of reconstructions, the procedures are generally associated

with fat grafting and fat re-injection⁵¹. In Dupuytren's disease, encouraging results were seen in the combination of the procedures sought and lipofilling⁴⁵, which increases the amount of adipose tissue present in the contracture area, as fat is generally present in minimal amounts in the hand.

It should be noted that in the literature, there is a wide range of terms that are used to describe procedures aimed at the manual resolution of fibrotic states: needle debridement^{52,53}, curettage with needles⁵⁴, needle decompression⁵⁵, and needle release⁵⁶⁻⁵⁸. These are mainly interventions on the superficial connective tissue, but in some cases, interventions extended to the deep connective tissue have been described.

Finally, a consideration must be made. All the procedures described, which act at the level of the hypodermis and concern the resolution of connective contractile states, fully fall within the definition of biological morphogenetic surgery⁵⁹. In fact, these are all minimally invasive surgical procedures aimed at restoring a condition of morphological and functional normality without radical interventions, instead by stimulating the natural biological reaction of the organism.

Conclusions

Aponeurotomy/fasciotomy and Rigottomy/subcision refer to different entities. Aponeurotomy/fasciotomy is used primarily in Dupuytren's contracture, a disorder of the superficial palmar aponeurosis. The particular structure of the superficial palmar aponeurosis may justify a specific name for the cut of the fibrotic connective tissue responsible for Dupuytren's disease. Indeed, Rigottomy/subcision is mostly used to address scar tissue retraction. All the techniques refer to the cut of collagen fibers connecting the superficial fascial plane with the dermis, with a course not parallel to the skin surface. Thus, they are not real fasciotomy, and this last term is theoretically incorrect. Although the surgical procedure is perfectly comparable, the underlying pathophysiology is totally different. That is, the different terms are used in different clinical contexts.

In answering the main question of this study, it makes no sense to use so many names for similar

procedures that have similar biological effects. A reason for using more terms can arise only from the different pathophysiology in which these techniques are employed. Can the experience gained in one field be extended to different fields? It probably could be, however more dialogue between doctors/surgeons is necessary. The comparison of both aesthetic and functional results of the various techniques suggests that the know-how acquired in different fields can be useful where problems related to the side effects of treatments are still relevant.

Furthermore, the clinical results obtained in the analyzed studies suggest that the study of the mechanisms of improvement of the dissection procedures of the fibrotic hypodermic connective tissue must continue.

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