Suprafascial Free Flaps: Classification and Comprehensive Review of the Literature

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Abstract

Study Design: Suprafascial free flaps have become common place in reconstructive surgery units. Nomenclature related to these flaps has not been uniform throughout the scientific literature, especially in regard to planes of dissection. This study is designed as a comprehensive review of the literature.

Objectives: Our study highlights which flaps are used most frequently, their main indications, their survival rate, and how they have evolved in the last few decades as innovations have been introduced.

Methods: A review of the literature was performed using keywords and Medical Subject Headings search terms. PubMed, Embase, and Cochrane Library were searched using the appropriate search terms. Data collected from each study included flap type, dissection plane, preoperative planning, area of reconstruction, as well as complications, donor-site morbidity and survival rate.

Results: Seven hundred and fifty-five studies were found based on the search criteria. After full-text screening for inclusion and exclusion criteria 34 studies were included. A total of 1332 patients were comprised in these studies. The most common types of flaps used were superficial circumflex iliac perforator flap (SCIP), anterolateral thigh flap (ALT), and radial forearm flap. The most common areas of reconstruction were head & neck and limbs. There was no significant difference in survival rates between flaps that were raised in different planes of dissection.

Conclusions: Based on the author’s review of the literature, suprafascial flaps are reliable, they have low donor site morbidity, and there is a wide selection available for harvest. The use of new technologies for preoperative planning, such as CT-Angiography and UHF ultrasound, have contributed to have more predictable results. We propose a standardized classification for these flaps, in order to create a uniform nomenclature for future reference.

Keywords
free flaps, suprafascial, thin
the muscle or muscle septum and into the skin and subcutaneous tissue superficially, leaving behind the muscle and sometimes deep muscle fascia. Using supermicrosurgical techniques that allow anastomosis of vessels less than 0.8 mm in diameter, these flaps could be raised without the need to dissect a long pedicle, and thus avoid trauma to the muscle.

Recently, studies carried out by Hong et al.⁵,⁶ show that a flap can be raised safely in the plane of the superficial adipose fascia that separates the superficial and deep fat lobules of the subcutaneous adipose tissue. We refer to free flaps raised in this plane as thin flaps.

As we can see, the evolution shows that soft tissue free flaps have become thinner as they are raised in a more superficial plane of dissection. This has been possible due to new technologies such a Computed Tomographic Angiography (CTA) and high-frequency ultrasound⁷ as well as a deeper knowledge in vascular anatomy such as the perforasome theory described by Saint-Cyr et al.⁸

Narushima et al.⁹ proposed a classification of thin flaps based on the anatomical plane on which they are raised: thin flaps dissected in the plane of the superficial adipose fascia, super thin flaps going above the superficial fascia, full thickness skin flap or pure skin perforator (PSP) flaps that are only as thick as the dermis and its superficial plexus of vessels, and split thickness skin flaps.

The objective of this study is to do a review of the flaps raised above the deep muscle fascia and their different variations. Our goal is to identify which flaps are used most frequently, their main indications, their survival rate, and how they have evolved in the last few decades as innovations have been introduced. We also propose a standardized classification for these flaps, to create a uniform nomenclature for future reference.

Materials and Methods

Between January 2019 and September 2020, a comprehensive search and review of the PubMed, Embase and Cochrane databases was carried out. This study has been conducted in accordance to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.¹⁰ Two independent reviewers (S.R. and S.H.) screened each study for relevance, conflicting studies were reviewed by a third reviewer (M.F). The following search terms were used: “suprafascial free flap,” “thin perforator flap,” “super thin perforator flap,” “ultra thin perforator flap,” and “pure skin perforator flap.” A complete list of keywords and medical subject headings is reported (Table 1).

The inclusion criteria were: 5 or more clinical cases, only free flaps, dissection plane above the deep muscle fascia, and accessibility through the aforementioned databases. The exclusion criteria were: secondary thinning of the flaps, cadaveric or radiological studies. Only English language articles were reviewed. Studies from the same institution with verified, identical, duplicated data were excluded.

After a thorough review of the selected articles, we identified the following variables: flap type, plane of dissection, preoperative imaging and planning, area of reconstruction, number of patients, complications, donor-site morbidity, flap survival, final outcome and conclusions. Information from the included studies was recorded using Microsoft Excel 2019.

In the variable “plane of dissection” we will use the following classification: suprafascial flap refers to the plane above the deep muscle fascia, thin flaps refers to the plane of the superficial adipose fascia, super thin for flaps dissected above the superficial adipose fascia, and pure skin perforator flaps (PSP) that are only as thick as the dermis and the subdermal vessel plexus. Institutional ethics

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**Table 1. Keywords, MeSH Terms and Search Syntax Used for Screening.**

| Database       | Search Terms                                                                                     |
|----------------|--------------------------------------------------------------------------------------------------|
| PubMed         | (“suprafascial”[All Fields] OR “suprafascially”[All Fields]) AND (“free tissue flaps”[MeSH Terms] OR (“free”[All Fields] AND “tissue”[All Fields] AND “flaps”[All Fields]) OR “free tissue flaps”[All Fields] OR (“free”[All Fields] AND “flap”[All Fields]) OR “free flap”[All Fields]), “thin”[All Fields] AND (“perforator flap”[MeSH Terms] OR (“perforator”[All Fields] AND “flap”[All Fields]) OR (“perforator”[All Fields] AND “flap”[All Fields]) OR (“perforator flap”[MeSH Terms] OR (“perforator”[All Fields] AND “flap”[All Fields]). (“super”[All Fields] OR “supers”[All Fields]) AND “thin”[All Fields] AND (“perforator flap”[MeSH Terms] OR (“perforator”[All Fields] AND “flap”[All Fields]) OR “pure”[All Fields] AND (“skin”[MeSH Terms] OR “skin”[All Fields]) AND (“perforator flap”[MeSH Terms] OR (“perforator”[All Fields] AND “flap”[All Fields]) OR “flap”[MeSH Terms] OR “perforator flap”[All Fields]) |
| Embase         | “suprafascial free flap” OR (suprafascial AND free (“flap”[exp OR flap]). “thin perforator flap” OR (thin AND perforator AND (“flap”[exp OR flap]). “super thin perforator flap” OR (super AND thin AND perforator AND (“flap”[exp OR flap]). “ultra”[All Fields] AND (“perforator flap”[MeSH Terms] OR (“perforator”[All Fields] AND “flap”[MeSH Terms]) OR “pure”[All Fields] AND (“skin”[MeSH Terms] OR “skin”[All Fields]) AND (“perforator flap”[MeSH Terms] OR (“perforator”[All Fields] AND “flap”[All Fields]) OR (“flap”[exp OR flap]). |
| Cochrane Library | MeSH descriptor: (suprafascial free flap): ti, ab, kw. explode all trees213. MeSH descriptor: (thin perforator flap): ti, ab, kw. explode all trees14. MeSH descriptor: (super thin perforator flap): ti, ab, kw. explode all trees622. MeSH descriptor: (ultra thin perforator flap): ti, ab, kw. explode all trees40. MeSH descriptor: (pure skin perforator flap): ti, ab, kw. explode all trees112. |
board approval was not required for this study, as it was a retrospective review of published literature.

**Results**

The initial literature search provided a total of 755 articles. We removed 203 duplicates from the selection, leaving 552 articles. After a first round of title and abstract screening, we removed 313 articles which were irrelevant to our study, leaving 239 articles. In the third round of screening, we completed full-text review and removed 205 articles based on our inclusion and exclusion criteria, leaving 34 articles for our final review (Figure 1).

We found a total of 34 articles that describe suprafascial free flaps and met all of our criteria. These studies are summarized in Table 2. There were 1332 patients included in these studies. The articles included were published between 1996 and 2020. Of these, 79% were published in the last 10 years. There were 14 articles that described flaps raised above the deep muscle fascia (suprafascial flaps), with 9 of them comparing suprafascial vs subfascial dissection planes. In 16 articles, the authors reported series of flaps raised on the superficial adipose fascia (thin flaps), with 1 of them comparing thin vs suprafascial dissection planes. There was 1 article that described ALT flaps raised above the superficial fascia (super thin), and compared them to the suprafascial dissection plane. In 3 articles Narushima presented clinical series of flaps dissected in a subdermal plane while preserving the subdermal vessel plexus (pure skin perforator flaps).

With regard to nomenclature, we found that the authors used different terms to describe the plane of dissection and the types of flap. If we consider Narushima’s classification of thin flaps, 94% of authors used this terminology. Those...
### Table 2. Main Characteristics of the Articles Included for Review.

| Year | Authors    | PMID       | Flap type | Plane of dissection | Planning | Area reconstruction | # of patients | Complications | Morbidity | Survival | Outcome/Conclusions |
|------|------------|------------|-----------|---------------------|----------|---------------------|---------------|---------------|-----------|----------|---------------------|
| 2020 | Wang       | 32591211   | SIEA      | THIN                | CTA, Duplex | Head & Neck         | 7             | Vein thrombosis | Low donor site morbidity, 12% dose. Visible scar | 100% | SIEA thin flap is a good option for soft tissue reconstruction of H&N |
| 2020 | Visconti   | 32718115   | SCIP      | THIN                | HHD, Duplex | Limbs and H&N       | 7             | N/A           | No available data | 100% | UHF-US is a very useful tool for planning of thin and superthin flaps |
| 2019 | Ullas Bali | 31663935   | ALT       | SUPRAFASCIAL        | CTA      | Limbs and H&N       | 19            | N/A           | No available data | 100% | CTA predicts the suprafascial course of perforators, increases safety |
| 2019 | D'Arpa     | 31307106   | ALT       | THIN                | CTA      | Axilla              | 12            | Wound dehiscence | Lower because 1 flap for bilateral reconstruction | 100% | Suprafascial dissection avoids 2’ and 3’ thinning |
| 2019 | Heredero   | 31233631   | PAP       | THIN                | CTA, HHD | Head & Neck         | 10            | Vasospasm      | Low donor site morbidity, 12% dose | 90% | PAP flap: Suprafascial dissection and pliable skin |
| 2018 | Narushima  | 30148784   | SCIP      | PSP                 | IGA, HHD | Ear and limbs       | 29            | Vein thrombosis | No available data | N/A | SCIP flaps have a reliable subdermal plexus and we can obtain PSP flaps from it |
| 2018 | Diamond    | 2913000    | ALT       | SUPER-THIN          | None     | Limbs and H&N       | 23 SPF, 12 ST | No difference | No difference between subfascial and suprafascial | 98% | Subfascial dissection took longer than Suprafascial |
| 2017 | Fisher     | 29132783   | ALT       | SUPRAFASCIAL        | None     | Limbs and H&N       | 20 SPF, 20 SPF | Similar for both | Similar for both | N/A | Sub- and suprafascial techniques are equivalent |
| 2017 | Lamans     | 28141212   | ALT       | SUPRAFASCIAL        | None     | Head & Neck         | 14            | N/A           | Low donor site morbidity, 12% dose | 93% | SCALP: Suprafascial increases flap pliability and reduces thickness |
| 2017 | Shanina    | 28016548   | Radial    | SUPRAFASCIAL        | None     | Head & Neck         | 25 SPF, 22 SPF | Similar for both | Suprafascial doesn’t increase harvest time | 100% | Suprafascial dissection decreases risk of tendon exposure |
| 2017 | Maruccia   | 2890694    | ALT       | SUPRAFASCIAL        | CTA, HHD | Limbs               | 34 SPF, 26 SPF | Similar for both | Lower morbidity in suprafascial | 96% | Less morbidity and less 2’ debulking |
| 2017 | Seth       | 28363228   | ALT       | THIN                | HHD      | Limbs               | 14 SPF, 11 Thn | Similar for both | Similar for both | 100% | Extremities: Suprafascial improves flap contour and pliability |
| 2016 | Narushima  | 27085610   | SCIP      | PSP                 | IGA, HHD | Duplex Hands        | 6             | Vein thrombosis | No available data | 100% | Hands: PSP flaps avoid the need for 2’ debulking, flap thickness of 2 mm |
| 2016 | Schwarzter | 27450896   | Radial    | SUPRAFASCIAL        | None     | Head & Neck         | 25 SPF, 25 SPF | Similar for both | Similar for both | N/A | No difference in success rate or morbidity |
| 2016 | Chen       | 27152581   | ALT       | SUPRAFASCIAL        | HHD      | Limbs               | 31 SPF, 30 SPF | Tendon exposure in sub | No available data | 96% | Suprafascial: Fewer abnormal sensations and higher satisfaction |
| 2015 | Kim        | 2632492    | TDAP      | THIN                | CTA, HHD | Limbs               | 13            | Partial flap loss | Less donor site morbidity | 85% | Provides good flap contour, large surface and volume when needed |
| 2015 | Kim        | 26220431   | SCIP      | THIN                | HHD      | Limbs               | 52            | N/A           | Low donor site morbidity, 12% dose | 92% | Better flap contour and volume, no need for 2’ debulking |
| 2015 | Goh        | 25357163   | SCIP      | THIN                | HHD      | Limbs and H&N       | 210           | Mostly in recipient site | Low donor site morbidity, 12% dose | 95% | SCIP: Reliable vascularity, thin skin flap. New “workhorse flap” |
| 2014 | Choi       | 25329846   | SCIP      | THIN                | CTA, HHD | Head & Neck         | 6             | N/A           | No available data | 100% | SCIP flap provides good contour and aesthetics for facial reconstruction |
| 2014 | Hong       | 24458881   | GAP       | THIN                | CTA, HHD | Limbs               | 27            | Partial flap loss | Low donor site morbidity, 12% dose | 100% | Good contour and thin flap, but short pedicle. Requires supermicro skills |
| 2014 | Kim        | 24211117   | LD        | THIN                | CTA      | Hands               | 7             | Partial flap loss | Scar contracture | 100% | LD flap is good for large, multi-digit and circumferential hand defects |
| 2013 | Narushima  | 23714796   | SCIP      | PSP                 | HHD, Duplex | Ear              | 9             | Partial flap loss | Lower incidence of ear infection than skin grafts | 88% | PSP flap allows reconstruction of EAC with minimal bulk |
| 2013 | Hong       | 23187712   | SCIP      | THIN                | CTA, HHD | Lower limb         | 71            | N/A           | Lower incidence of lymphoedema | 95% | SCIP: Avoids debulking, perforator-to-perforator anastomosis |
| 2013 | Hong       | 2308140    | ALT       | THIN                | CTA, HHD | Limbs and H&N       | 54            | N/A           | Some donor sites required skin grafts for closure | 98% | ALT can be raised safely in the superficial fascial plane |
| 2012 | Riva       | 2387444    | AMT       | SUPRAFASCIAL        | HHD      | Head & Neck         | 41            | N/A           | Good subjective perception and functional tests | 95% | AMT flap is a good back up flap if the ALT fails and has low morbidity |
| 2011 | Avery      | 22079565   | Radial    | SUPRAFASCIAL        | None     | Head & Neck         | 30 SPF, 30 SPF | No available data | N/A | Similar sensory recovery, except for palmar light touch |

(continued)
| Year | Authors | PMID   | Flap type | Plane of dissection | Planning | Area reconstruction | # of patients | Complications | Morbidity | Survival | Outcome/Conclusions                      |
|------|---------|--------|-----------|--------------------|----------|---------------------|---------------|---------------|-----------|----------|---------------------------------------|
| 27   | 2011 Sagalongos | 21701330 | Fibula    | SUPRAFASCIAL       | HHD      | Head & Neck         | 18 SPF, 9 SBF | N/A           | Low donor site morbidity, no alteration to ankle | N/A       | Less morbidity and better contour outcome |
| 28   | 2007 Daberger | 17825774 | Scapular  | THIN               | HHD      | Limbs               | 5             | N/A           | Low donor site morbidity, 12 closure             | 100%      | Scapular flap: High quality, hairless skin paddle, with chimeric options |
| 29   | 2007 Avery  | 17537558 | Radial    | SUPRAFASCIAL       | None     | Head & Neck         | 121           | Skin graft, Tendon exposure          | Less morbidity with suprafascial dissection   | 97%       | Radial flap is reliable, and suprafascial dissection has less morbidity |
| 30   | 2006 Avery  | 16061309 | Radial    | SUPRAFASCIAL       | None     | Head & Neck         | 20 SBF, 20 SPF | N/A           | No available data                        | N/A       | No difference in sensory recovery       |
| 31   | 2006 Kimura| 16525296 | Groin/    | THIN              | HHD      | Limbs               | 11            | 28%           | Minimum donor site morbidity              | 100%      | Thin groin flap (future SCIP) provides thin, pliable skin with a long pedicle |
| 32   | 2001 Kim   | 1124052  | LD        | THIN              | HHD      | Limbs               | 12            | N/A           | Low donor site morbidity, 12 closure       | 100%      | Thin LD flap has constant thickness, vascular supply, and low morbidity |
| 33   | 1999 Lutz  | 9915173  | Radial    | SUPRAFASCIAL      | None     | Head & Neck         | 95            | N/A           | Complete skin graft is better             | 96%       | Less morbidity and higher take of skin grafts, avoids 2 complications |
| 34   | 1996 Chang | 9016457  | Radial    | SUPRAFASCIAL      | None     | Head & Neck         | 49            | N/A           | Less tendon exposure, better sensory recovery | N/A       | Less donor site morbidity in suprafascial dissection |

Abbreviations: SIEA, superficial inferior epigastric artery perforator flap; ALT, anterolateral thigh flap; AMT, anteromedial thigh flap; PAP, profunda artery perforator flap; DIEP, deep inferior epigastric perforators flap; SCIP, superficial circumflex iliac perforator flap; TDAP, thoracodorsal artery perforator flap; GAP, gluteal artery perforator flap; LD, latissimus dorsi flap; UHF-US, ultra-high frequency ultrasound; HHD, hand-held acoustic Doppler; Duplex, color Doppler ultrasound; CTA, CT angiography; MRA, magnetic resonance angiography; IGA, indocyanine green angiography; SPF, suprafascial; SBF, subfascial; ST, super thin; N/A, no available data. Radial refers to the radial forearm flap. Scapular refers to the thin circumflex scapular artery perforator flap. Fibula refers to the free fibula flap. 

<sup>*</sup>primary closure.
that did not use this nomenclature referred to thin flaps as super thin flaps.\textsuperscript{11,12}

There were 12 different types of flaps used in the articles reviewed. The frequency of the flaps that were used was as follows: superficial circumflex iliac perforator flap (SCIP) 8 articles (398 total patients), anterolateral thigh flap (ALT) 7 articles (309 total patients), radial forearm flap 7 articles (462 total patients), latissimus dorsi (LD) 2 articles (19 patients in total). The following had 1 article per flap type: scapular, fibula, superficial inferior epigastric perforator flap (SIEA), thoracodorsal artery perforator flap (TDAP), deep inferior epigastric perforator flap (DIEP), profunda artery femoris flap (PAP), gluteal artery perforator flap (GAP), and anteromedial thigh flap (AMT).

A summary of indications and outcomes grouped by the different flap types is provided in Table 3. These indications and outcomes are solely based on the articles included in this review, and do not include the full range of indications for the flaps listed.

The most common area of reconstruction was head and neck (21 articles, 748 patients), followed by limbs (14 articles, 610 patients). Other areas of reconstruction included hands (2 articles, 13 patients) and axilla (1 article, 12 patients). The number of patients included ranged from 5 to 210 patients, with an average of 43 of patients per study.

Preoperative imaging planning to find dominant perforators was done in 67\% of articles. The most common method of imaging was the hand-held acoustic Doppler (9 articles, 444 patients), followed by CT-Angiography (3 articles, 38 patients) or a combination of both (7 articles, 248 patients). Other forms of preoperative planning included ultra-high frequency ultrasound (UHF-US) (4 articles, 29 patients) and indocyanine green angiography (1 article, 29 patients). No preoperative planning was done with radial forearm flaps.

The complication rate was generally underreported, with many articles not making any mention of them (only 50\% of studies made direct reports of complications). In general, they included partial flap loss (6\%), wound dehiscence (8\%), vein thrombosis (9\%), seroma (2\%) and tendon exposure in radial flaps (up to 20\% in subfascial dissection). However, most authors did mention that the rate of complications was similar for both suprafascial and subfascial flaps (mentioned in 5 out of the 9 articles that made the comparison).

The donor site morbidity of the flaps was low in all cases, and allowed for primary closure in 85\% of cases (except in radial flap). Most articles that reported donor site morbidity showed that it was similar in subfascial and suprafascial dissections (12 out of 34 articles). Suprafascial dissection showed less morbidity over the subfascial dissection in ALT flaps.\textsuperscript{13} In radial flaps, suprafascial dissection has shown to decrease tendon exposure and improved healing of skin grafts.\textsuperscript{14-17} Fibula flaps dissected in the suprafascial plane have also shown lower donor site morbidity and better wound contour.\textsuperscript{18} Thin flaps (dissected in the superficial adipose fascia) have also shown to improve donor site aesthetics due to a more uniform wound contour and higher primary closure rate.\textsuperscript{5}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
Flap type & Indications & Outcomes \\
\hline
ALT & Head and Neck & 97.27\% survival. Good option for soft tissue reconstruction, long pedicle (10-12 cm), customizable thickness. \\
& Limbs (especially lower limb) & \\
\hline
AMT & Head and Neck, Limbs & 95\% survival. AMT flap is a good back up flap if the ALT fails. \\
\hline
DIEP & Axilla, Breasts & 100\% survival. Provides a large-surface flap which can be split to reconstruct multiple sites. \\
\hline
Fibula & Head and Neck & Suprafascial dissection provides lower donor site morbidity and better wound contour. \\
& Mandible reconstruction & \\
\hline
GAP & Limbs (especially lower limb) & 100\% survival. Good contour and thin flap, but short pedicle. Requires supermicrosurgical skills. \\
\hline
LD & Limbs (especially upper limb and hands) & 100\% survival. LD is good for large circumferential defects; it has a constant thickness and vascular supply. \\
\hline
PAP & Head and Neck (especially tongue) & 90\% survival. Thin and pliable flap, with customizable thickness. \\
\hline
Radial & Head and Neck & Lower donor site morbidity with suprafascial dissection. 97.67\% survival. Thin and pliable flap with long pedicle. \\
\hline
Scapular & Limbs & 100\% survival. Hairless skin paddle, with chimeric options (muscle and bone). \\
\hline
SCIP & Head and Neck & 96.25\% survival. Reliable vascularity, thin, pliable skin with a long pedicle. Provides lymph nodes to improve lymphatic drainage. \\
& Limbs & \\
\hline
SIEA & Head and Neck & 100\% survival. Good option for soft tissue reconstruction of H\&N. \\
\hline
TDAP & Limbs & 85\% survival. Provide good flap contour and large surface. \\
\hline
\end{tabular}
\caption{Indications and Outcomes Grouped by the Different Flap Types (Based on the Articles Included in This Review).}
\end{table}
All free flaps had survival rates of more than 85%. The flaps that presented the best survival rates based on more than 50 patients in the study were radial forearm (97.67%, 263 patients), ALT (97.29%, 258 patients), and superficial circumflex iliac perforator (SCIP) flap (96.25%, 369 patients). The following list shows the rest of the survival rate average based on the flap type: gluteal artery perforator (GAP) flap (100%, 27 patients), latissimus dorsi flap (100%, 19 patients), deep inferior epigastric artery perforator (DIEP) flap (100%, 12 patients), superficial inferior epigastric artery (SIEA) perforator flap (90%, 10 patients), anteromedial thigh (AMT) flap (95%, 41 patients), and thoracodorsal artery perforator (TDAP) flap (85%, 13 patients).

There was no significant difference in survival between flaps that were raised in different planes of dissection. Suprafascial flaps had a 96.14% survival rate, based on 498 flaps that were included. Thin flaps had a 96.78% survival rate, based on 529 flaps that were included. Super thin flaps had a 98% survival rate, based on 12 flaps that were included. PSP flaps had a 99% survival rate, based on 15 flaps. Using a one-way ANOVA test no significant statistical differences were found between these survival rates ($P = 0.16$).

**Discussion**

In this study we conducted a thorough review of the literature in regard to suprafascial free flaps. We presented the most useful techniques available for reconstruction that require thin, pliable and customizable flaps, and only included articles with clinical cases and significant caseloads, in order to show the reader feasible and reliable practices.

When looking at the chronological order and evolution, we see that initially soft tissue free flaps were dissected in a subfascial plane, therefore, when surgeons required a thin flap the one that was used the most was the radial forearm flap. Next there was a progressive surge in the use of perforator flaps, following studies carried out by Wei et al.\textsuperscript{19,20} describing a perforator-based ALT flap. Following this there have been different types of perforator flaps described, and the trend has been to leave behind the fasciocutaneous flaps for cutaneous perforator flaps in an ever-thinner plane of dissection. In our study we see that in the first 10 years radial flaps were primarily being used, then SCIP flaps, and in the last 10 years mostly ALT. Almost 80% of the articles included were published in the last decade,\textsuperscript{21-36} indicating that this a very contemporary subject in reconstructive surgery (Figure 2).

In regard to the nomenclature, some authors used the term suprafascial indistinctively when mentioning the deep and superficial fascia. Also, some referred to thin flaps as super thin.\textsuperscript{11,12} This was noted in the 34 articles that we reviewed in depth, but there was a lack of consensus in regard to the definition of these terms in the scientific literature. For this reason, we believe that adopting a common classification is necessary and we propose to use the following classification: Subfascial = below the deep muscle fascia, Suprafascial = above the deep muscle fascia but below the superficial adipose fascia, Thin flaps = dissected on the plane of the superficial adipose fascia, Super thin flaps = dissected above the superficial adipose fascia, Pure skin perforator (PSP) flaps = include only the skin and subdermal plexus vessels (Figure 3).
According to the literature, the main areas of reconstruction were head and neck, and limbs. This is because these areas normally require thin and pliable flaps, with long pedicles for anastomosis. For example, even though the radial forearm flap is the most commonly used flap for tongue reconstruction after hemiglossectomy, flaps like the PAP or ALT flap are preferable alternatives that provide thin and pliable tissue when they are dissected as thin flaps. Heredero et al. demonstrated that these thin flaps can be obtained even in obese patients when dissected above the superficial adipose fascia.

Most of the reviewed series of flaps dissected above the deep or the superficial fascia include preoperative imaging planning. Studies carried out by Heredero et al. with CT-angiography and Visconti et al. using ultra-high frequency ultrasound (UHF-US) allow us to map out the patterns of the perforating vessels in the suprafascial plane preoperatively. When we combine this knowledge with hand-held acoustic Doppler and/or duplex ultrasound, we have high confidence in the anatomical disposition of the vessels in our flaps. This improves flap survival and shortens operating time. It also allows us to have thinner flaps, which are more suitable for extremity or head and neck reconstruction, and have lower donor site morbidity. These flaps combined with super-microsurgical techniques, which allow us to anastomose ever smaller vessels (in general under 0.8 mm in diameter), improve our reconstructive options and lead to better outcomes.

Donor site morbidity has been improved with the advent of suprafascial flaps. Our series of articles show that donor site morbidity in suprafascial dissection is either similar or better than subfascial dissection, with no authors reporting inferior results. Suprafascial flaps also provide better wound contour and aesthetics, decrease the risk of tendon exposure and improve the healing of skin grafts in the radial forearm flap donor site, as well as allowing for a higher rate of primary closure in the ALT flap donor site.

One of the key aspects that has allowed for thin flaps to become mainstream today, is that the flap survival is independent to the plane of dissection. Studies carried out by Hong and Chung and Narushima et al. showed that if the vascular network of vessels is preserved, we can dissect extremely thin flaps. These authors also described 3 key areas which are critical to flap survival and must be carefully manipulated, which are the subdermal plexus, the perforating vessels that go through the deep muscle fascia, and the microsurgical anastomosis. Some flaps require customized design to see the perforating vessel patterns, and this is where new technologies have had an important role.

Conclusions
Suprafascial free flaps are becoming the new workhorse for surgeons as their variety and reliability have improved. We have seen that these flaps are just as reliable as subfascial flaps, they have less donor site morbidity, and there is a wide selection available for harvest. The use of new technologies for preoperative planning, such as CT-Angiography and UH-F ultrasound, have contributed to have more predictable results and they are becoming common techniques for surgeons harvesting these flaps. We propose a standardized classification for these flaps, in order to create a uniform nomenclature for future reference.

Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.
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