INTRODUCTION
According to the 2018 American Society for Plastic Surgeons database, the number of cosmetic procedures using platelet-rich plasma (PRP) as soft tissue fillers accounted for 0.8% of all cosmetic non-surgical procedures. In contrast to 2017, PRP use has increased by 12%, which accounts for the fourth fastest growing cosmetic procedure. As PRP has been progressively becoming popular in plastic surgery, its uses in plastic surgery have expanded to aesthetic, craniofacial, hand, and reconstructive surgery.

Currently, platelet-rich plasma is used in various types of procedures and surgery, given its theorized benefits of enhancing wound healing, collagen production, angiogenesis, and remodeling. It can be used as topical applications or injections, and it is widely popularized in aesthetic and craniofacial surgery. In aesthetic surgery, it can be used in facelifts to decrease ecchymosis and edema, lasers to assist with wound healing, fat grafting to increase fat retention, and hair transplantation to enhance hair regrowth. For craniofacial surgery, it is used in bone grafts, fistula repairs, dental implants, and maxillofacial reconstruction.

Despite the increased popularity of PRP in plastic surgery, there is no detailed analysis on the level of evidence on PRP use in plastic surgery. As the number of applications of PRP in plastic surgery increases, it is important for plastic surgeons to understand the scientific and validated evidence behind its use. Therefore, we performed a literature review to identify current level of evidence on platelet-rich plasma in plastic surgery.

Background: Despite the increased popularity of platelet-rich plasma (PRP) in plastic surgery, there is no detailed analysis on the level of evidence on PRP use in plastic surgery. As the number of applications of PRP in plastic surgery increases, it is important for plastic surgeons to understand the scientific and validated evidence behind its use. Therefore, we performed a literature review to identify current level of evidence on platelet-rich plasma in plastic surgery.

Methods: We performed a computerized search of platelet-rich plasma in plastic surgery using the MEDLINE, Cochran Library, and EMBASE databases. Data regarding the type of study, PRP application, and outcomes were collected. Then, the level of evidence was assigned using the American Society of Plastic Surgeons Level of Evidence Rating.

Results: Our search identified 105 articles, and about 78.1% of studies were lower-quality studies: 37 level-III articles (35.2%), 32 level-IV articles (30.5%), and 13 level-V articles (12.4%). There were only 6 level-I articles and 17 level-II studies. Level-I studies were on facial rejuvenation using a laser, carpal tunnel release, cleft lip repair, trauma wounds, breast reconstruction using latissimus dorsi, and hair regrowth.

Conclusions: Our review of the literature shows that the level of evidence on PRP use in plastic surgery is low (21.9%). Nevertheless, we believe level-III to level-V studies are still valuable, as performing high-level quality studies in plastic surgery is difficult due to variability in surgical techniques, experiences, and materials.

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METHODS

We performed a computerized search of the MEDLINE, Cochran Library, and EMBASE databases using the search term, platelet-rich plasma, and following search terms:

- Aesthetic surgery
- Breast surgery
- Craniofacial surgery
- Hand surgery
- Plastic surgery
- Reconstruction

The following limits were applied for each search:

- Subjects: humans
- Language: English
- Dates: no limits
- Age groups: no limits

Exclusion criteria were as follows: (1) review articles; (2) animal studies; and (3) articles not in English.

All studies were reviewed and evaluated by one of the authors (MJC). Data regarding the type of study, PRP application, objective measurement of the outcomes, PRP preparation method (baseline and final platelet count, force and length of centrifugation, use of anticoagulation), and journal type were collected. Then, each article was reviewed, and the level of evidence was assigned to each article using the American Society of Plastic Surgeons Level of Evidence Rating Scale (Table 1).

RESULTS

The computerized search was performed on April 11, 2020. A total of 854 articles were identified from the initial search: aesthetic surgery, n = 101; breast surgery, n = 25; craniofacial surgery, n = 287; hand surgery, n = 44; plastic surgery, n = 99; and reconstructive surgery, n = 298. After reviewing the abstracts of each article, 105 studies of potential relevance remained: aesthetic surgery, n = 39; breast surgery, n = 4; craniofacial surgery, n = 23; hand surgery, n = 3; plastic surgery, n = 15; and reconstructive surgery, n = 21 (Fig. 1).

All 105 articles were further evaluated, and the level of evidence for each article was determined using the American Society of Plastic Surgeons Evidence Rating Scale. The analysis of 106 studies revealed 6 level-I articles (5.7%), 17 level-II articles (16.2%), 37 level-III articles (35.2%), 32 level-IV articles (30.5%), and 13 level-V articles (12.4%) (Fig. 2, Table 2).

Aesthetic Surgery

Of the 101 articles from the initial search, 39 articles remained after the initial review: 1 level-I, 3 level-II, 17 level-III, 15 level-IV, and 3 level-V studies (Table 3). The majority of the studies were on fat grafting, followed by microneedling and injection of PRP for facial rejuvenation. Of the 4 high-quality evidence-based studies, level-I study was a prospective, blinded study on the patients who received a fractional carbon dioxide laser with PRP. Level-II studies were on the following: microneedling, acne scar, and lipofilling of face. Apart from these 4 studies, 89.7% of the studies had a lower level of evidence.

Breast Surgery

Four articles were identified on the use of PRP on breast surgery (1 level-I and 3 level-III articles). The level-I article studied the effect of PRP to minimize drain amount and to prevent seroma formation in latissimus dorsi breast reconstruction, whereas level-III articles were on breast fat grafting.

Craniofacial Surgery

For the craniofacial surgery, the majority of the studies were on bone graft (74%), and the remaining 26% of the studies were on cleft lip repair, cleft palate repair, distraction osteogenesis, oronasal fistula repair, and osteonecrosis. There was one level-I study on the effect of PRP on the scar width of primary cleft lip repair. For the level-II study, a study on the effect of PRP in distraction osteogenesis was identified. Similar to the other fields, the majority of the studies were lower-quality studies such as level III (17.3%), level IV (39.1%), and level V (26%).

Hand Surgery

Three articles were identified for PRP use in hand surgery (1 level-I and 2 level-II). The level-I study was on the effect of PRP on the carpal tunnel release. Level-IV studies were on the use of PRP in the setting of amputation and in patients with basal thumb arthritis.

Plastic Surgery and Reconstructive Surgery

Fifteen studies were identified using the search term, “plastic surgery.” Of the 15 studies, there were 2 level-I studies; randomized placebo-controlled trial on the effect of PRP in hair regrowth and use of PRP in the management of acute trauma wounds. The level-II studies were on the use of PRP on blepharoplasty, chronic wounds, alopecia, and fractional CO₂ laser therapy. Other studies were lower quality studies on fat grafting (3), keloid (1), osteonecrosis (1), wound healing (2), and meta-analysis (1).

For the reconstructive surgery, bone graft was the most commonly studied (28.6%), followed by wound healing and fat grafting to breast. The majority of the studies were lower-quality studies (66.7%), and level-III studies (38%) were the most common level of evidence.

PRP Preparation and Efficacy

Of the 105 studies we reviewed, the concentration of baseline and final platelets was reported only in 18.3% and 21.5%, respectively. The force and length of the centrifugation was documented in 74.2%, and the use of anticoagulation was reported in 9.7% of the studies. For the PRP efficacy, only 53.8% of the studies objectively measured the outcomes after the PRP application.

DISCUSSION

Recently, application of platelet-rich plasma has become popular in the field of plastic surgery, given its theoretical ability to promote wound healing, stimulate collagen production, and improve in overall
healing. Therefore, many surgical specialties such as dentistry, oral and maxillofacial surgery, orthopedics, ophthalmology, and gynecology have begun to use PRP in their practice. Similarly, plastic surgeons have begun to use PRP in their practice, especially in aesthetic procedures such as fat grafting, alopecia, facial rejuvenation, and laser.

Despite the increased popularity of PRP in plastic surgery, there is no detailed analysis on the level of evidence of PRP applications in plastic surgery at this time. Therefore, we performed a computerized search to determine the level of evidence on PRP applications using aesthetic surgery, breast surgery, craniofacial surgery, hand surgery, plastic surgery, and reconstructive surgery as search terms.

Our search identified 105 articles, and 78.1% of studies were lower-quality studies: 37 level-III articles (35.2%), 32 level-IV articles (30.5%), and 13 level-V articles (12.4%). There were only 6 level-I articles and 17 level-II studies. Level-I studies were on facial rejuvenation using a laser, carpal tunnel release, cleft lip repair, trauma wounds, breast reconstruction using latissimus dorsi, and hair regrowth. Level-II studies were on distraction osteogenesis, bone graft, wound healing, burns, facelift, blepharoplasty, alopecia, laser, microneedling, lipofilling of face, and skin graft.

Our review of the literature revealed that the level of evidence on PRP use in plastic surgery is low (21.9%). This phenomenon is in agreement with the published finding.

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**Fig. 1.** Article selection process.
of low level of evidence in plastic surgery. Sinno et al found that the average level of evidence in plastic surgery is low (PRS, 3.05; JPRAS, 3.35; Annals, 3.31, and Aesthetic, 3.11), and only 2.2% of studies were level I. The average level of evidence in our study was 3.3, and over 40% of the studies were level IV or V, which were case series or case reports. Of these, the majority of the studies were on bone graft, which was most likely due to theoretical advantages of enhancing bony healing with growth factors from the platelets. The popularity of PRP was also observed in the field of dentistry and maxillofacial surgery. Similarly, a large percentage of level-III studies were on fat grafting and facial rejuvenation.

In addition to the low level of evidence on PRP use in plastic surgery, the quality of PRP preparation and assessment of PRP efficacy was inadequate. The majority of the studies did not report baseline or final platelet concentration, which determines the dose and effectiveness of the factors in the PRP. Furthermore, the vast majority of the studies did not report previous use of anticoagulation by the patient (90.3%), which also impacts the efficacy of the platelets. Several systematic reviews on the clinical efficacy of PRP in aesthetic surgery have already shown that there is a lack of consistency and standardization in the preparation and application of the PRP. In addition, many studies did not assess the clinical efficacy of PRP objectively. This phenomenon was also observed in our study, which identified 53.8% of studies reporting objective measurement of PRP efficacy.

Furthermore, we performed a detailed analysis of level-I studies using the Jadad scale. The Jadad scale evaluates the quality of randomized trials by asking these 3 questions: (1) Was the study described as randomized? (2) Was the study described as double blind? (3) Was there a description of withdrawals and dropouts? For each question, score 1 was given if the answer was “yes.” Of the 6 level-I studies, 4 studies had a Jadad score of 1, and 2

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Table 1. American Society of Plastic Surgeons Evidence Rating Scale for Therapeutic Studies

| Level of Evidence | Qualifying Studies |
|-------------------|--------------------|
| I                 | High-quality, multi-centered or single-centered, randomized controlled trial with adequate power; or systematic review of these studies |
| II                | Lesser quality, randomized controlled trial; prospective cohort or comparative study; or systematic review of these studies |
| III               | Retrospective cohort or comparative study; case-control study; or systematic review of these studies |
| IV                | Case series with pre/post test; or only post test |
| V                 | Expert opinion developed via consensus process; case report or clinical example; or evidence based on physiology, bench research or “first principles” |
studies had a Jadad score of 2. This finding reveals that randomized controlled trials, which are the highest level of evidence studies, were poorly performed.

Our study shows that the current level of evidence in platelet-rich plasma is low, and this phenomenon is most likely due to the inherent nature of our specialty. Historically, plastic surgery fell behind the other specialties in adopting evidence-based medicine due to the lack of objective assessment, steep learning curves, and difficulty with standardization in the field of plastic surgery. However, there has been an increase in the average level of evidence in the past several decades, and we anticipate that there will be an increase in the number of higher quality studies on PRP use, as its use continues to expand. 34,38,39

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### CONCLUSIONS

Since the introduction of evidence-based medicine in the 1980s, it has become commonplace for physicians to practice evidence-based healthcare. However, plastic surgeons have been slow to adopt evidence-based medicine compared with the other specialties.39,40,42 Our review of the literature reveals that there is a limited number of high-quality studies on PRP use in plastic surgery. In addition, the quality of PRP preparation and assessment PRP efficacy performed in these studies was low. However, we believe level-III to level-V studies are still valuable, as performing high-level quality studies in plastic surgery can be challenging. Furthermore, we anticipate that there will be an increase in the number of higher quality studies on PRP use, as its use continues to expand. 34,38,39

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### Table 2. Detailed Analysis of the Studies Based on the Level of Evidence

| Level of Evidence | No. Articles |
|-------------------|--------------|
| Aesthetic surgery |              |
| I                 | 1            |
| II                | 3            |
| III               | 17           |
| IV                | 15           |
| V                 | 3            |
| Breast surgery    |              |
| I                 | 1            |
| III               | 3            |
| Craniofacial surgery |          |
| I                 | 1            |
| II                | 3            |
| III               | 4            |
| IV                | 9            |
| V                 | 6            |
| Hand surgery      |              |
| I                 | 1            |
| IV                | 2            |
| Plastic surgery   |              |
| I                 | 2            |
| II                | 4            |
| III               | 5            |
| IV                | 3            |
| V                 | 1            |
| Reconstructive surgery |        |
| II                | 7            |
| III               | 8            |
| IV                | 3            |
| V                 | 3            |

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### Table 3. Distribution of Articles per Sub-specialty

| Sub-specialty          | No. Articles |
|------------------------|--------------|
| Aesthetic surgery      |              |
| Acne scar              | 1            |
| Fat grafting to breast | 4            |
| Fat grafting to face   | 7            |
| Facelift               | 2            |
| Hyaluronic acid        | 2            |
| Hyperpigmentation      | 1            |
| Keloid                 | 1            |
| Laser                  | 3            |
| Microneedle            | 5            |
| PRP injection          | 5            |
| Radiofrequency         | 1            |
| Rhinoplasty            | 2            |
| Sutia                 | 2            |
| Wound healing          | 2            |
| Breast surgery         |              |
| Drain                  | 1            |
| Fat grafting           | 3            |
| Craniofacial surgery   |              |
| Bone graft             | 17           |
| Cleft lip repair       | 1            |
| Cleft palate repair    | 1            |
| Distraction osteogenesis |          |
| Oronasal fistula repair |          |
| Osteonecrosis          | 2            |
| Hand surgery           |              |
| Amputation             | 1            |
| Arthritis              | 1            |
| Carpal tunnel syndrome |              |
| Plastic surgery        |              |
| Alopecia               | 3            |
| Blepharoplasty         | 1            |
| Fat grafting to face   | 2            |
| Fat grafting to breast | 1            |
| Keloid                 | 1            |
| Laser                  | 1            |
| Metz-analysis          | 1            |
| Osteonecrosis          | 1            |
| Wound healing          | 4            |
| Reconstruction         |              |
| Acne scar              | 1            |
| Alopecia               | 1            |
| Blepharoplasty         | 1            |
| Bone graft             | 6            |
| Burn                   | 1            |
| Facelift               | 1            |
| Fat grafting to breast | 2            |
| Hidradenitis           | 1            |
| Skin graft             | 1            |
| Soft tissue atrophy    | 1            |
| Systemic review        | 1            |
| Wound healing          | 4            |

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