



SYSTEMATIC REVIEW

Current materials and techniques in cosmetic hand injections

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ABSTRACT

Background: With the widespread popularity and development of aesthetic treatments, the focus has extended from facial aging to include the aging of hands. The primary aim of this study is to review the current materials, methods of injection, and testing procedures employed in cosmetic hand injections.

Methods: PubMed database (from 1971 to April 2024) was searched to identify relevant studies on materials, injection techniques, and evaluation methods associated with aesthetic hand injections, excluding systematic reviews and medical record reports.

Results: A total of 1815 articles were identified, of which 41 articles were included. This study summarizes the current materials, injection techniques, and outcome evaluation methods used for cosmetic hand injections, while discussing observations and making recommendations.

Conclusion: Hand skin conditions tend to receive less attention than cosmetic facial injections. In existing studies of injected substances, hydroxyapatite remains the main material used for cosmetic hand injections. Poly-L-lactic acid (PLLA), platelet-rich plasma (PRP), and polycaprolactone injections were significantly more effective than other substances in the hand. In commonly used injection techniques, catheter-based injection methods are more accurate than needle positioning and dose. The most commonly used assessment methods remain ultrasound and the Merz hand partial scale. At present, there is still a relative lack of research on aesthetic hand injections, and extensive and in-depth research, such as randomized studies comparing hyaluronic acid and calcium hydroxylapatite and longitudinal data on the results of PLLA or PRP, is recommended to further develop hand injection techniques with lasting aesthetic results. Increased public awareness of hand injections derives from more reliable and valid studies. And we need standardized outcome measures and long-term follow-up data in future studies.

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Introduction



As age changes, the problem of hand aging becomes more and more prominent, and patients' needs for improving the condition of their hands gradually increase [1]. The popularity of facial rejuvenation surgery and the increasing availability of treatments have prompted an increased demand for hand rejuvenation of up to 60% [2, 3]. In fact, an article published in *Plastic and Reconstructive Surgery* as early as 2006 proposed that hand condition can independently reflect a person's age [4]. A study points to an increased need to close the gap between youthful faces and aging hands; at the same time, as the use of masks becomes routine during and after the COVID-19 pandemic, hands have become the first visible sign of the body's aging index [5, 6]. Soft-tissue volume is the most important factor in perceived hand esthetics [7]. Aging of the hands can manifest as soft-tissue atrophy, wrinkling, increased discoloration, excessive protrusion of bones, tendons, veins, etc [8, 9]. Similar to the face, improvements to the hands can be divided into two main categories: surgical and non-surgical. Autologous fat grafting is the preferred surgical option, combined with laser or chemical treatment of the epidermis [10]. Non-surgical techniques include dermal filler injections. Fillers have the advantages of convenience, satisfaction, and minimal trauma [11, 12]. They

are widely accepted by patients and are a common technique for hand rejuvenation. This systematic review summarizes the commonly used, safe, and effective injection materials as well as the existing injection and detection methods, which provides ideas for the follow-up research on hand injection materials and calls on more researchers to pay more attention to the problem of hand aging.

Methods

Search keywords and data extraction

The authors searched the PubMed database for studies related to hand injections until the end of April 2024, including the injection site (hand), injection materials (hyaluronic acid [HA], calcium hydroxylapatite [Ca-HA], collagen, poly-L-lactic acid [PLLA], polycaprolactone [PCL], platelet-rich plasma [PRP], and botulinum toxin), needle specifications (size and diameter), detection methods (ultrasound analysis), and observation indicators. The authors limited the search to English language reports and exclude reports not related to the subject, non-English reports, or reports related to other injection sites and methods. Specific inclusion and exclusion criteria are shown in Table 1.

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Table 1. Literature screening criteria.

Inclusion criteria	Exclusion criteria
Randomized controlled trial or retrospective review	Case reports, systematic review, or meta-analysis
Hand	Other sites
Injection	Other methods

Data management and excursion assessment

This review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. All articles were independently screened by three investigators, and those that met the inclusion criteria were screened. Systematic reviews and meta-analyses were excluded due to the lack of original experimental data, while case reports were excluded because of their strong individuality and limitations. In case of uncertainty, three investigators discussed the relevant articles and reached consensus, summarizing from three aspects: injection material, injection method, and evaluation method.

Results

Overall distribution

Of the 1815 studies identified, a total of 41 studies were finally included after screening against exclusion criteria (Figure 1). Of the remaining 41 articles, 30 were related to hand injection materials, of which 10 were related to HA (33.3%), 8 to Ca-HA (26.7%), 5 to PLLA application in the hand (16.7%), 1 to PCL (3.3%), and 3 to PRP application in the hand (10%). Because Botox is mainly used in the treatment of hand diseases, there is no literature on hand injection rejuvenation. Thirty studies were related to the injected material, two to the method of injection, and nine to the method of examination. The specific data are shown in Table 2.

Table 2. All data.

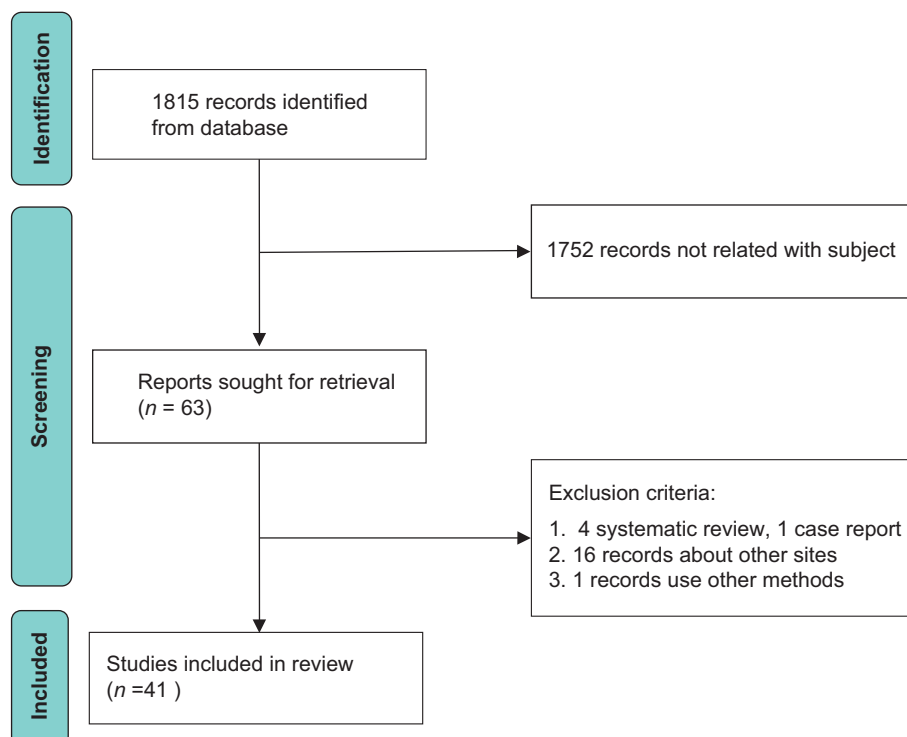
Content	Number (n, %)
Injection materials	30 (73.2)
HA	10 (33.3)
Ca-HA	8 (26.7)
PLLA	5 (16.7)
PCL	1 (3.3)
PRP	3 (10.0)
Botulinum toxin	0 (0.0)
Injection methods	2 (4.9)
Examined methods	9 (22.0)

Injection materials

Among the 30 articles related to hand injection materials, 10 were HA related (33.3%), 8 were Ca-HA related (26.7%), 5 were about the application of PLLA in hand (16.7%), 1 was about PCL (3.3%), and 3 were about the hand application of PRP (10%) (Figure 2). Because Botox is mainly used for the treatment of hand diseases, there is no literature on hand injection beauty. The properties of different hand injection materials are shown in Table 2.

Hyaluronic acid

HA is the most common dermal filler used for both facial and hand treatments [13]. It addresses wrinkles and volume loss not only through filling and volumizing but also by hydrating the injected area (nasolabial folds, popliteal fossa, malar fat pads, leading lines, labial enhancements, and inter-brow lines) due to its water affinity. HA has also been examined as a potential skin restorer in intermediate-effect therapies, which involve multiple microinjections into the dermis to rejuvenate the skin [14]. Following injection, patients achieved safe, effective, and lasting outcomes due to HA's unique chemical-physical properties, biocompatibility, biodegradability, and versatility [1,

**Figure 1.** Flowchart of the literature screening process.

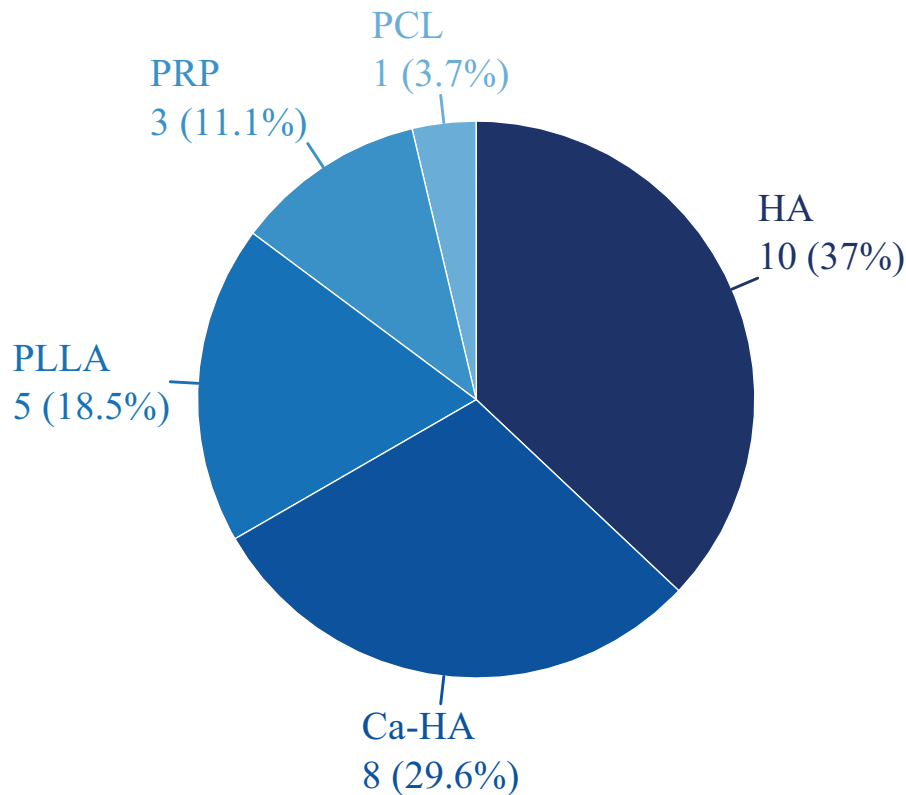


Figure 2. Distribution of different materials in the 30 studies related to injection materials that were included. PLLA: poly-L-lactic acid; PRP: platelet-rich plasma; PCL: polycaprolactone; HA: hyaluronic acid; Ca-HA: calcium hydroxylapatite.

15–21]. There are two types of HA: stable (S-HA) and non-stable (NS-HA). Studies have shown that S-HA has superior effects compared to NS-HA [20, 22]. A study has indicated that HA demonstrated superior efficacy compared to collagen [23]. In addition, recent studies have shown that HA can act as a skin booster. A 2007 study observed fibroblast elongation and collagen regeneration after injecting cross-linked HA fillers into the forearms of 11 elderly patients [24, 25]. Although the improvement after HA injection is significant at all time points, it is still necessary to acknowledge the possible complications, need for remediation, and appropriate dosages [26]. A study tested the effect of large granule HA on initial impressions following hand injection. The results showed that after treatment, the initial impression scores of all experimental groups increased, further demonstrating the effectiveness of HA in hand injections [27].

Calcium hydroxylapatite

Ca-HA is chemically identical to the calcium component of bones and teeth, which provides the product with a high degree of biocompatibility. In recent years, it has been utilized as a radiopaque dermal filler to provide volume correction in the dorsal hands [28]. A 2-year, prospective, single-center, open-label study demonstrated that Ca-HA injections in the hands do not obscure the bones as observed on X-rays up to 24 months post-injection, thus attesting to its safety [29]. Meanwhile, relevant controlled experimental studies have demonstrated that the dorsal intermediate lamina is a loosely structured and easily stretchable layer [30]. Regardless of whether the injection is administered at the sub-dermal level using a cannula or by a needle in the deep fat lamina, there is no significant difference in the injection effect. However, considering patient satisfaction and the risk of adverse reactions, the use of cannulas is recommended [31]. Ca-HA is classified as an adjustable filler, in contrast to HA, which is fully

reversible through hyaluronidase digestion. Adverse effects, such as swelling and edema post-injection, are common and can sometimes be debilitating. The combination of certain reagents (e.g. triamcinolone and foam sclerotherapy) without the cosmetic effect not only avoids negatively impacting treatment efficacy but also dramatically reduces adverse effects, thereby improving patient experience and treatment tolerance [32, 33].

Compared to HA, Ca-HA exhibits stronger tissue lifting and skin-tightening effects. Premixing HA with Ca-HA can enhance the collagen-stimulating properties of HA fillers, while high G prime HA can provide additional volume while maintaining tissue softness, thereby enhancing the effectiveness of Ca-HA fillers [34]. Additionally, due to the rapid absorption of the carboxymethyl cellulose gel carrier before the new collagen formation induced by Ca-HA granules takes effect, the area injected with Ca-HA sometimes experiences unexpected early volume loss. Moreover, significantly more bruising and swelling were observed in the hands injected with Ca-HA compared to those injected with HA. When HA is premixed with Ca-HA, HA can compensate for this early volume loss, and Ca-HA is known to have a longer-lasting effect than most types of HA [11]. Therefore, in the long term, the premixing of HA and Ca-HA can extend the duration of the filler treatment's effect.

Collagen

Collagen, a widely used dermal filler in cosmetic surgery, can be divided into bovine collagen and porcine collagen [35]. Due to its consistency, flow characteristics, lack of longevity, and the resulting uneven skin surface, bovine collagen is rarely used for correcting hand appearance [36]. In the context of hands, unlike faces, collagen is often used in the treatment of post-burn hand malfunctions and certain hand contracture diseases, such as Dupuytren's Contracture [37, 38].

PRP

The presence of various growth factors in platelets renders PRP a potent tool for stimulating collagen regeneration in aging skin [39]. A recent study conducted a prospective, randomized clinical trial in which 18 women with aged hands received PRP injections into one hand every 4 weeks for a total of 12 weeks, while the other hand received saline injections in a randomized, controlled, single-blind manner. At 12 and 24 weeks of follow-up and evaluation, researchers found only slight skin changes, understanding that PRP may not be an effective option for hand rejuvenation [40]. Furthermore, the application of PRP can reduce the visibility of skin blood vessels, promote collagen synthesis, and increase the number of fibroblasts and blood vessels in the superficial dermis [41]. One study that conducted a controlled clinical trial to investigate the relationship between PRP and fat transplantation concluded that fat grafting with PRP was safe and associated with minimal side effects after 1 year [42].

Poly-L-lactic acid

Hands remain a particularly challenging area to treat with any technique. However, polylactic acid presents a promising solution to this problem [9]. Polylactic acid filler, the first sustained collagen stimulator initially used on the face, can now also be applied to other areas with increased volume, contouring, and loose skin, such as the neck, chest, arms, and thighs. In the hand, PLLA mainly addresses the problem of volume loss and must be injected into the thin subcutaneous layer on the back of the hand, avoiding muscles, tendons, and veins [43]. The US Food and Drug Administration has approved injectable PLLA for the correction of shallow to deep nasolabial fold contour deficiencies, other facial wrinkles, and the restoration and/or correction of signs of facial lipoatrophy related to the human immunodeficiency virus [44]. Some studies have demonstrated that aesthetic restoration of the hands with injectable PLLA may yield satisfactory results, consistent with those reported for facial applications [45, 46].

Polycaprolactone

The non-HA bioresorbable PCL-based filler, known for its collagen-stimulating properties, has a proven safety profile. It is typically used on the face to improve signs of aging and has a low complication rate, with rare cases of nodules and/or granulomas. Although there are not enough reports demonstrating the use of PCL in the hand, PCL filler has been determined to be effective for improving dorsal hand volume loss with minimal side effects [47].

Botulinum toxin

Botulinum toxin is a common facial injection used to mitigate wrinkles and combat aging [48]. However, no research has shown its effectiveness in addressing aging issues in the hand. Instead, it is more commonly used to treat muscle spasms and muscle tone-related diseases, such as systemic sclerosis, Parkinson's disease, and Raynaud's syndrome in the hand [49].

Injection methods

The literature on hand injection methods is limited, with only three research reports in this field. Botulinum toxin is primarily used in the hand for treating limb spasms and focal dystonia. A controlled trial compared two types of electrophysiological guidance: electrical stimulation and ultrasound. The study concluded that both methods were

equally effective, but ultrasound was recommended for patient comfort [50]. A 2015 study investigated the efficacy and safety of injecting Radiesse® with a needle versus a cannula for hand aging. A 6-month clinical trial involving 10 women with consistent hand aging issues found no significant differences in efficacy or safety between the two injection methods [51]. In addition, a recent study demonstrated that the use of a trocar for injecting soft-tissue fillers can precisely deliver the product to a predetermined tissue plane [52]. Injecting fewer products into deeper tissues improves accuracy. In a 2019 study, a five-step method for hand rejuvenation was proposed for HA injections. The process involves wrapping the skin and injecting the filler perpendicular to the skin while carefully avoiding veins and extensor tendons on the back of the hand. The injection area was then massaged with ultrasonic gel, and a post-injection assessment was conducted [53]. The method of conducting a safety check through ultrasound after a sharp needle injection is rather cumbersome. Therefore, the injection method using a cannula needle to spread the skin and dermis layer on the back of the hand remains the most effective and safe injection method at present.

Examined methods

Ultrasound analysis

Ultrasound is a noninvasive technology that has been widely used in various fields of medicine and plays an important role in hand injections [54]. Atrophy of hand adipose tissue is a key indicator of hand aging. Ultrasound technology has revealed that there are three layers of hand adipose tissue: the dorsal superficial layer (DSL), the dorsal intermediate layer (DIL), and the dorsal deep layer (DDL). The study also found that as age increases, the volume of these three fat layers decreases, with the reduction of the DIL being particularly noticeable after the age of 30 [6].

With advancements in ultrasound technology, skin-targeted ultrasound and high-frequency ultrasound have emerged, both of which are noninvasive technologies. Skin-targeted ultrasound technology revealed that the subepidermal low echo band (SLEB) is associated with chronic ultraviolet radiation [55]. The lower the SLEB echo, the higher the photoaging. Consequently, this technology can be used to evaluate the effectiveness of skin photoaging treatments. High-frequency ultrasound operates at a frequency of 20–100 MHz, which can clearly distinguish each layer of skin. The ultrasound data can be quantified, making it useful for evaluating age-related changes in the dermis [56].

Hand grading scale

The Merz Hand Score (MHGS) is a commonly used scale for physicians to evaluate the condition of their patients' hands. It is a 5-point scale that can be used for both photographic assessment of the back of the hand and on-site assessment [57]. With its highly weighted *K*-value and consistent surface, the MHGS is a suitable and tested tool for clinicians to consult with patients and evaluate changes after hand rejuvenation treatment [58].

In 2019, a new hand grading scale, the Hand Volume Rating Scale (HVRS), was proposed. This 5-point numerical rating scale, with 0 (absent), 1 (mild), 2 (moderate), 3 (moderate to severe), and 4 (severe), is used for objectively evaluating the volume change of the hand in Asians. Developed by five experienced plastic surgeons, the scale considers the degree of fat loss and the visibility of veins and tendons as key scoring factors. However, as the participants in the study were all Asians, the applicability of the scale may be limited [59].

Table 3 shows a comparative analysis of ultrasound and the two evaluation scales from the perspectives of sensitivity, reproducibility, and clinical feasibility.

Other method

With the advancement of 3D technology in recent years, it has been integrated into various fields. In the field of injectable esthetics, many handheld 3D systems have emerged, offering a noninvasive, accurate, and repeatable method for evaluating the volume of injections in the face, vulva, and hands. The selection of these systems is based on clinical needs and available resources [60].

Discussion

This systematic review indicates that HA and Ca-HA, according to the number of published studies, are the most commonly used materials for hand rejuvenation injections. The incidence of mild complications is low, and no related serious complications have been reported. Among all the materials, patient satisfaction is high, and the aesthetic effect tends to be more lasting. With the rapid development of facial injection esthetics, the importance placed on the appearance of the hands is gradually increasing, extending beyond the use of hand creams, masks, and other single external methods for hand skin maintenance. Fat transplantation is another method of hand rejuvenation that can fill the defective tissue of the hand to achieve rejuvenation. However, it is more invasive, and the survival rate and maintenance time of the injected fat tissue are limited, with a higher risk of complications [61]. Therefore, compared to fat transplantation to improve the aging state of the hand, people tend to prefer a less invasive, effective, and more lasting aesthetic solution – hand injection.

In plastic surgery, botulinum toxin is frequently used as an anti-aging component for facial treatments [62]. Although there are risks of complications such as headaches, local skin reactions, and facial neuromuscular symptoms, it remains a popular product for facial wrinkle removal when applied with the correct injection method and appropriate dosage [63, 64]. However, our review has found that in the context of hand treatments, unlike its use in facial applications, botulinum toxin is commonly used as a treatment for muscle spasms and dystonia-related disorders, and it is seldom used for cosmetic purposes in the hands [65–68].

Despite the popularity of facial injections, surprisingly, there are very few studies focused on hand injections, and most of the injection materials are already well known [69]. Our review indicates that there have been no new injection materials for hand cosmetic surgery introduced since the research on hand rejuvenation materials conducted 3 years ago, while there are increasingly diverse injection materials available for the face, neck, and eyelids, such as concentrated growth factors (CGFs) [70], stem cells, platelet-rich fibrin (PRF), etc., which are considered safer, more effective, and more durable [71–73]. Concurrently, there are few reports on the cosmetic use of popular injection materials like PLLA, PCL, and PRP, which have been widely

used in facial treatments with notable effectiveness and high patient satisfaction, particularly over the past 5 years [71, 74, 75]. Furthermore, no serious complications were reported following the injections, and patient satisfaction was high.

To analyze the reasons, first, this study has certain limitations. Our research only included articles published in English and was restricted to one database, PubMed, without considering other databases, which might lead to a lack of comprehensive data. Second, people tend to prioritize the functional use of their hands over their appearance, resulting in a general neglect of hand esthetics. Consequently, few people opt for hand rejuvenation procedures. The lack of widespread acceptance of hand cosmetics, coupled with insufficient research support, means that during patient consultations, we cannot provide adequate references, thereby reducing the number of potential patients and leading to a lack of clinical data support, forming a vicious cycle. Third, from an evidentiary standpoint, compared to populations in other regions, the issue of hand aging among Asians is not severe. Unless combined with other diseases, normal individuals rarely exhibit serious hand tissue defects as they age, which also contributes to the low number of hand injections.

Based on our systematic review, we have several suggestions regarding hand injections. We recommend that more plastic surgeons focus on research into hand aging, further develop hand injection techniques with long-lasting aesthetic effects, and work toward improving public awareness of hand injections.

Conclusion

At present, beauty hand injection materials that can be used mainly include HA, collagen II, PLLA, Ca-HA, and PRP, in which HA and Ca-HA are reported as widely used materials. Needle and cannula are mainly used for injection. Although there is no significant difference in the injection effect between the two groups, the cannula has higher patient satisfaction and accuracy. Ultrasound and MHGS are still the main methods to evaluate the state of hand aging and the efficacy of treatment. Although there is a lag in hand injections compared to facial injections, with the increased attention and research on hand injections, we believe that plastic surgeons will have to pay more attention to clinical research and clinical practice work on hand injections in the future to find more effective and long-lasting minimally invasive rejuvenation materials.

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The authors have no financial interest to declare in relation to the content of this article.

Disclosures

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Data acquisition

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author upon reasonable request.

Conflicts of interest

None declared.

Table 3. Comparison of examined methods.

Examined methods	Sensitivity	Reproducibility	Clinical feasibility
Ultrasound	Sensitive	Repetitive	Feasible, with clear and reliable results
Merz Hand Score	Common	Repetitive	Feasible, but subjective.
Hand Volume Rating Scale	Common	Repetitive	Not feasible, more limited

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Ethical approval

Not required.

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