Received: 9 November 2023 | Accepted: 16 January 2024

DOI: 10.1111/srt.13679

ORIGINAL ARTICLE

WILEY

An evaluation of the effectiveness of 'ULTRACOL 200' in enhancing nasolabial fold wrinkles through cutaneous repair

Nguyen Ngan Giang[1,2] | Hyun Ji Kim[3] | Pham Ngoc Chien[2,3] | Han Jin Kwon[4] | Jung Ryul Ham[4] | Won Ku Lee[4] | Yeon Ju Gu[4] | Shou Yi Zhou[2,5] | Xin Rui Zhang[2,5] | Sun Young Nam[2] | Chan Yeong Heo[1,2,3,5]

[1]Department of Medical Device Development, College of Medicine, Seoul National University, Seoul, Republic of Korea

[2]Department of Plastic and Reconstructive Surgery, Seoul National University Bundang Hospital, Seongnam, South Korea

[3]Korea Institute of Nonclinical Study, H&Bio. co. Ltd., Seongnam, Republic of Korea

[4]UltraV Co., Ltd. R&D Center, Seoul, South Korea

[5]Department of Medicine, College of Medicine, Seoul National University, Seoul, Republic of Korea

Correspondence
Sun Young Nam and Chan Yeong Heo, Department of Plastic and Reconstructive Surgery, Seoul National University Bundang Hospital, Seongnam, Korea.
Email: 99261@snubh.org and lionheo@gmail.com

Abstract

Background: Injectable filler, a nonsurgical beauty method, has gained popularity in rejuvenating sagging skin. In this study, polydioxanone (PDO) was utilized as the main component of the ULTRACOL200 filler that helps stimulate collagenesis and provide skin radiant effects. The study aimed to evaluate and compare the effectiveness of ULTRACOL200 with other commercialized products in visually improving dermatological problems.

Methods: Herein, 31 participants aged between 20 and 59 years were enrolled in the study. 1 mL of the testing product, as well as the quantity for the compared groups was injected into each participants face side individually. Subsequently, skin texture and sunken volume of skin were measured using ANTERA 3D CS imaging technology at three periods: before the application, 4 weeks after the initial application, and 4 weeks after the 2nd application of ULTRACOL200.

Results: The final results of skin texture and wrinkle volume evaluation consistently demonstrated significant enhancement. Consequently, subjective questionnaires were provided to the participants to evaluate the efficacy of the testing product, illustrating satisfactory responses after the twice applications.

Conclusion: The investigation has contributed substantially to the comprehension of a PDO-based filler (ULTRACOL200) for skin enhancement and provided profound insight for future clinical trials.

KEYWORDS
collagen formation, filler, polydioxanone, skin enhancement, Ultracol200

1 | INTRODUCTION

Skin aging is a natural process occurring when people age, characterized by the loss of standard skin properties such as elasticity, firmness, and moisture, resulting in wrinkles, fine lines, and crownfeets.[1–3] Skin aging can be attributed to intrinsic (genetic) and extrinsic factors such as UV exposure, lifestyles, and pollution.[4–6] The impact of skin aging varies individually; however, age spots and uneven skin tone can be observed by the naked eye due to decreased collagen and elastin production to maintain dermal layers of skin.[7,8] Consequently, the skin

becomes more susceptible to external damages from environmental factors that may irreversible injures it.

Among aging traces, nasolabial fold wrinkles are the most noticeably fundamental indicators of aging shown in lower facial regions that diminish youth-looking facial appearance. There has been a broad application of non-invasive surgery that can be utilized to reconstruct and improve visual facial characteristics in aging, such as laser therapy, thread-lifting, chemical peeling, micro-needling, botox injecting, and filler.[9–11] Among those, the dermal filler has now received significant attention in retrieving, rejuvenating, and enhancing skin smoothness and texture through its versatile applicability that can be performed in different areas such as eyes, lips, forehead, cheek, and neck.[12–14] Additionally, dermal filler can be applied to substitute the defection of soft tissue volume due to skin aging.[15]

Polydioxanone (PDO) is a biodegradable polymer with polar ester linkage that exhibit a reactive nature in a chemical reaction, which undergoes gradual hydrolysis for 4 to 6 months and slowly gets absorbed by the body.[16–18] During this process, it is known to stimulate the production of fibroblasts, leading to increased collagen synthesis in the targeted area, resulting in wound healing rate and strength intensified simultaneously, followed by the degradation of PDO in the body.[19–21] Additionally, ascribed to the higher tensile strength compared with other biodegradable polymers, PDO enables the filler matrix to prevent deformation from external factors and secure the injected filler layer under the skin.[22,23]

A noteworthy dermal filler that has garnered interest is ULTRACOL200, which combines PDO and SCMC with the intention of improving skin texture and volume. This research seeked to assess the safety and efficacy of ULTRACOL200 through a thorough analysis and survey evaluations. Additionally, the research aimed to establish the superiority of our product by comparing it to other established market products, namely REJURAN, JUVELOOK, and Hyront Inj.

2 | METHODS

This research was conducted for a duration of 8 weeks, during which the ULTRACOL200 filler was applied twice (the first application at 4 weeks and the second application at 8 weeks). Regarding subject information, 36 participants, aged between 20 and 59 years, initially met the selection and exclusion criteria and were enrolled in the study. However, five participants were subsequently excluded, leaving a finale of 31 participants (37.13 ± 8.30 years, range 21–56 years) who completed the study protocol.

Detailed explanations regarding the study's objectives, methodology, expected efficacy, and potential skin adverse reactions were provided to the participants. After expressing their willingness to participate, the individuals visited the clinic for the initial visit, where they underwent the wash-off period and provided informed consent. Baseline information was collected from the participants by the research personnel.

2.1 | The selection criteria for participants in this study were as follows

(1) Applicants aged between 20 and 59 years with concerns about wrinkles in the nasolabial fold area, (2) Healthy individuals without acute or chronic medical conditions, including skin diseases, (3) Individuals who provided voluntary informed consent and understood the study procedures, and (4) Individuals available for follow-up during the study period.

The criteria were established to include individuals of the appropriate age range with concerns about nasolabial fold wrinkles, ensuring good overall health and willingness to participate. Voluntary informed consent was required, and participants available for the study duration were included for feasible assessments and data collection.

2.2 | Participant exclusion criteria

(1) Participants who are pregnant, breastfeeding, or planning to become pregnant within the next 6 months, (2) Participants with skin diseases such as severe inflammation, eczema, psoriasis, skin cancer, skin allergies, sensitive skin, or hypersensitivity, (3) Participants who have used antimicrobial agents, immunosuppressants, steroid-containing topical agents, or chronic skin disease treatments for more than 1 month in the treatment area, (4) Participants who have participated in the same study within the past month, (5) Participants with chronic systemic diseases such as asthma, diabetes, or hypertension, (6) Participants who are continuously taking contraceptives, antihistamines, or anti-inflammatory drugs, (7) Participants who are employees of the clinical research center, and (8) Other participants were deemed unsuitable for the study based on the investigators judgment.

Exclusion criteria were applied for safety and study integrity. Pregnant or nursing individuals were omitted due to potential risks. Skin conditions, allergies, and interfering treatments led to exclusions. Chronic diseases and specific medications were also reasons for exclusion. Research center staff were excluded for impartiality. Investigator judgment further excluded unsuitable candidates.

2.3 | Criteria for study discontinuation and participant exclusion

(1) Cases where participation in the study is not feasible due to clear adverse reactions: The reason should be recorded as"adverse reaction"with the detailed information provided in the case report form, (2) Cases where participants voluntarily request to discontinue their involvement: The reason should be recorded as"withdrawal of consent,"(3) Cases where the test product is used less than 10% of the total planned usage: The reason should be recorded as"protocol violation,"(4) Cases where the investigator determines that the participants continued participation in the clinical study is inappropriate

(e.g., criminal behavior, illegal activities): The specific reason should be recorded on the study termination page, (5) Cases where the investigator determines that the concurrent use of drugs/medical devices or surgery/procedures that may affect safety or efficacy evaluations has occurred during the study period, (6) Cases where the participant participates in another clinical study during the study period, (7) Cases of failed follow-up observation, and (8) Cases where, for reasons other than those mentioned above, the results cannot be included in the study analysis (e.g., major missing data or data errors/damage affecting the calculation of results): The reason should be recorded as "other".

These criteria were enforced to uphold study integrity and results validity. Documenting adverse reactions or participant withdrawals enabled adverse event monitoring. Protocol violations and discontinuations maintained study design adherence. Investigator assessment and confounding factor identification ensured study accuracy. Failed follow-ups and unforeseen issues were recorded for data transparency.

2.4 | Calculation of sample size

Following the standards for test technique validation for cosmetics labeling and advertising, a minimum sample size of 20 participants was recruited and included in the study for statistical significance in the comparative analysis of the result data.

2.5 | Research methodology

In this study, participants were instructed to cleanse the test area and then rest in a temperature and humidity-controlled room (22 ± 2°C, 50 ± 5%) for 20 min before participating in the study.

2.6 | Application procedure for testing products

The test product was administered to the participants' selected test region (nasolabial fold wrinkles on both sides of the face) at 4-week intervals for a total of two treatments. Before putting the filler into the participants selected face region, a topical anesthetic cream was administered and kept on for 30 min. After the cream was removed, a 25G sterile cannula needle or a 25G sterile injection needle was attached and used to deliver the filler in a volume of no more than 1.0 mL.

2.7 | Measurement of skin textures and skin volume (sunken area)

The selected face region was collected using Antera 3D CS (Miravex Limited, Ireland) three times in this study: before the medical device application, 4 weeks after the first application, and 4 weeks after the second application. The photos were processed with software to determine skin texture and volume factors. The measuring apparatus used multi-directional lighting to acquire photos from various angles on the skin surface and then used a computer to recreate the 3D properties of the skin surface to measure the total topography of the skin surface using shading and shape analysis methods.

2.8 | Skin texture analysis parameters

The parameter "Rt: Maximum Height" is defined as the height between the maximum peak and the lowest point of the profile within the evaluation length.

2.9 | Skin volume analysis parameter

"Volume" (mm3) is defined as the negative value representing the volume relative to the normalized surface within the selected area.

2.10 | Photography

The selected face region was collected utilizing VISIA CR (Canfield, USA) at three time intervals in this study: before the medical device application, 4 weeks after the first application, and 4 weeks after the second application. Both optical and polarized modalities were used to capture the photos.

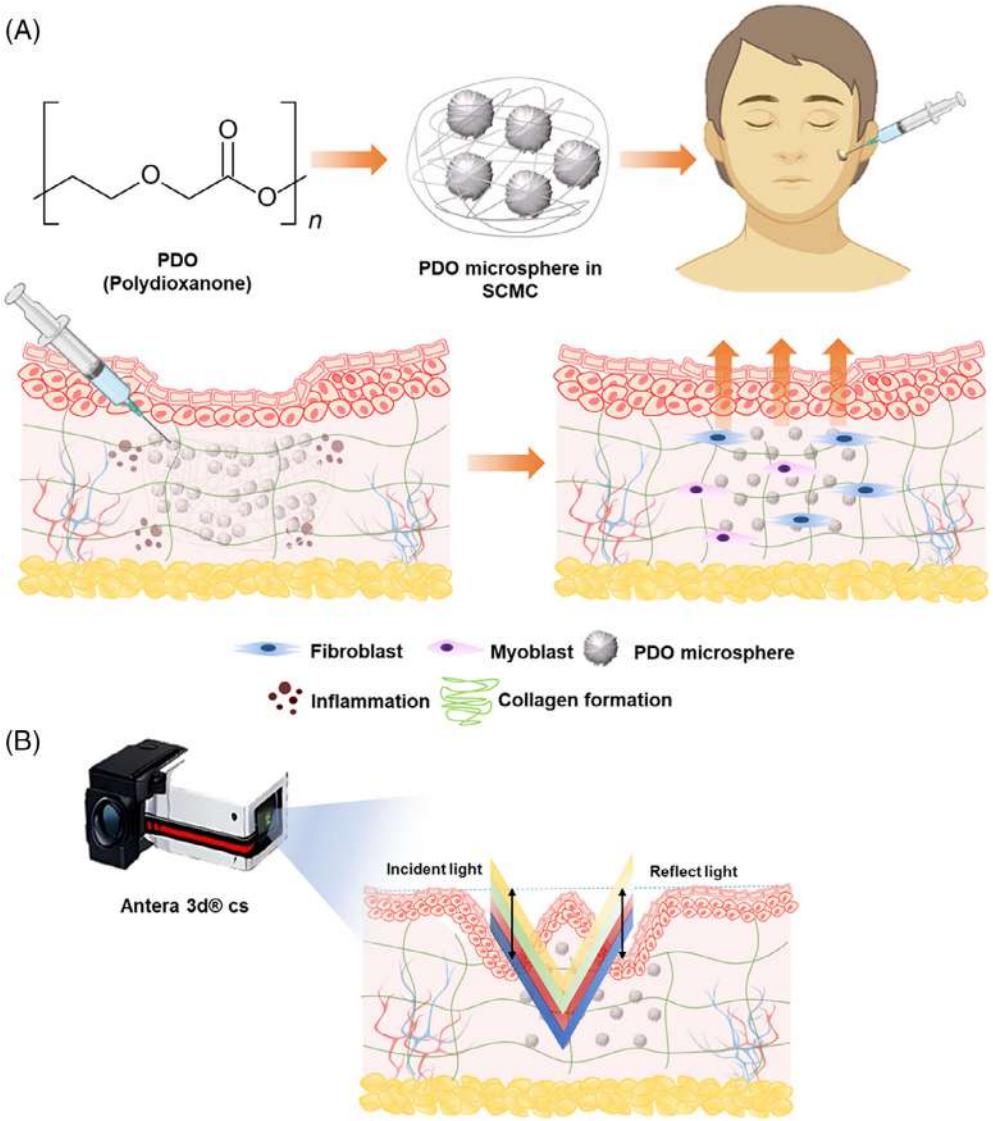
2.11 | Participants self-assessment

Participants were given a questionnaire about the products efficacy and usability 4 weeks after the first application and 4 weeks after the second application of the medical device. Participants assessed the items on a 6-point scale (1 point for 'Not at all' / 6 points for "Very much," with responses ranging from 4 to 6 points representing a positive response percentage (%).

2.12 | Statistical analysis

To evaluate statistical significance, the data acquired will be examined using the SPSS package program (IBM, USA). The Shapiro-Wilk test and measurements of kurtosis and skewness will be used to determine the datas normality. For before-after comparisons with parametric data, paired t-tests will be performed. Friedman's test will be used for non-parametric data, followed by Wilcoxon signed-rank tests and posthoc testing (Bonferroni correction) (p 0.05).

Homogeneity will be tested among groups using paired t-tests, and homogeneity will be regarded when $p > 0.1$. If groups are homogenous, repeated measures analysis of variance (RM-ANOVA) will be used for between-group comparisons of evaluation outcomes. If the groups are not homogenous, the analysis of the covariance (ANCOVA) method will be used (p 0.05).



SCHEME 1 Schematic illustration: (A) PDO microsphere in SCMC to create ULTRACOL200 filler. The ULTRACOL200 filler helps stimulate collagen formation by the activation of fibroblasts. (B) Skin assessment principle by ANTERA 3D, the two-sided arrows indicated the sunken areas or the skin volumes occupied that cause deep wrinkles.

The rate of change is calculated by:

$$\% = \frac{\text{Before application} - \text{After application}}{\text{Before application}} \; x\,100$$

3 | RESULTS

In this study, we investigated the efficacy of the dermal filler-based PDO (ULTRACOL200) in skin improvement, as shown in the schematic illustration. The ULTRACOL200 filler is expected to enhance the cutaneous problems that enable to retain a youthful look by the stimulation of neocollagenesis (Scheme 1A). ANTERA 3D, an optical device utilizing multi-directional illumination to capture and create 3D images from various angles, was used to characterize, measure and analyze skin topography (Scheme 1B).

Three commercial filler products from different companies (REJURAN, JUVELOOK, Hyront Inj) were assumed to be control groups to compare with the testing group (ULTRACOL200) to elaborate and evaluate the effectiveness of the product.

3.1 | Effect of ULTRACOL200 on reducing skin texture

To evaluate the efficacy of ULTRACOL200 in reducing skin texture, 1 mL of the testing product as well as the amount for the control products, was separately injected into each face side of the participants. Subsequently, the measurement, assessment, and captures of the skin texture were achieved by ANTERA 3D in three periods of time: before the application of the fillers, 4 weeks after the 1st application, and

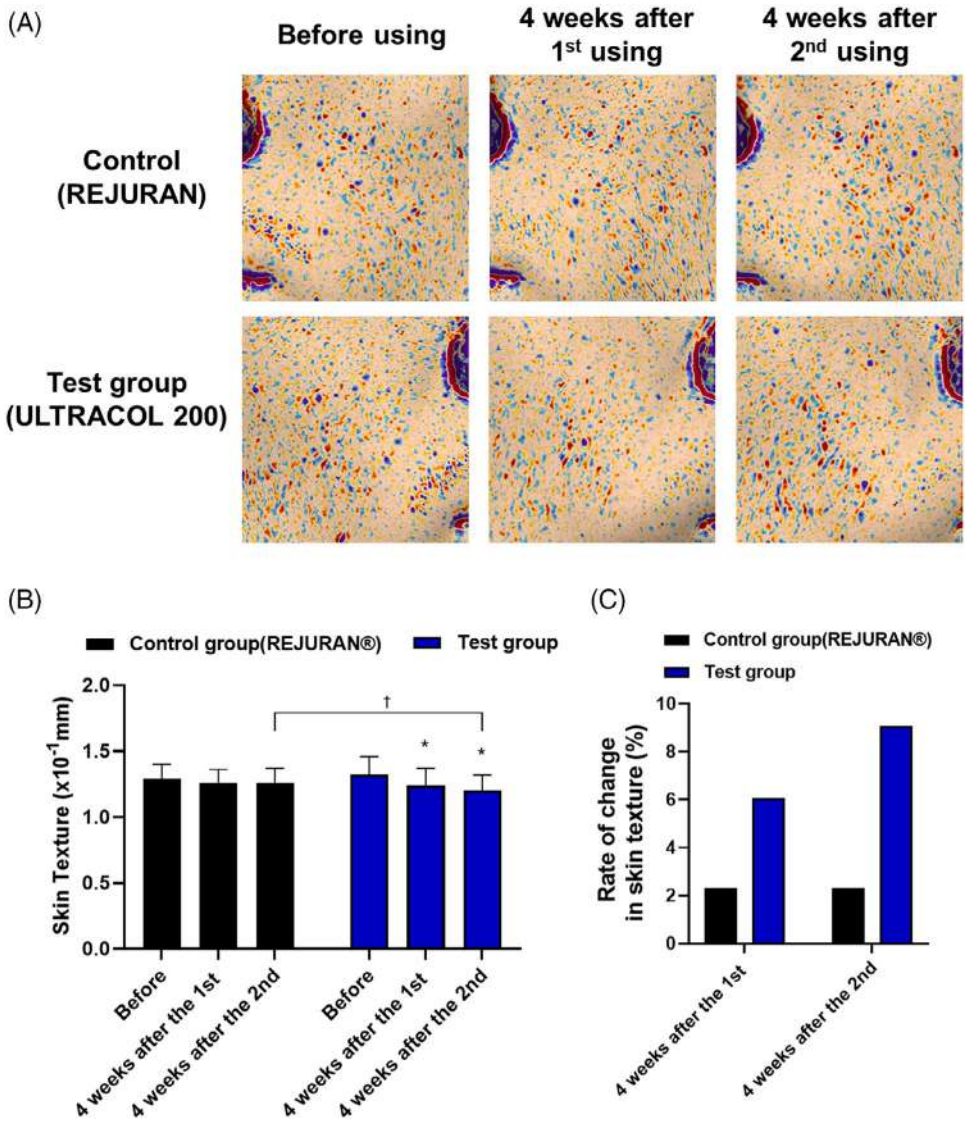


FIGURE 1 Illustrative images of the donor, captured using Antera 3D CS (Miravex Limited, Ireland). Panel (A) showcases the improvement in skin texture, while Panel (B) and (C) demonstrate quantitative analyses of skin texture measurement and the rate of change in skin texture, respectively (Mean ± SEM, $^*p < 0.05$, $n = 10$).

4 weeks after the 2nd application (Figure 1A, 2A, 3A). The reduction of skin texture was calculated and defined by the height of the maximum point and the lowest point on the skin surface, represented in the area of colorful dots.

The quantitative results showed that there was no significant difference in the REJURAN group after twice applications, while the testing group (ULTRACOL200) displayed a noticeable decrease in skin texture, ranging from 1.32 to 1.24 and 1.20 ($x10^{-1}$ mm) (Figure 1B). The change of "before application" and "each period of application (4 weeks after 1st application and 4 weeks after 2nd application)" in percentage was calculated to clearly show the efficacy difference in the texture improvement of the control group and testing group. When compared with the testing group ULTRACOL200 by percentage, the REJUVAN group exhibited a less percentage of change (2.33%) than the testing group (6.06%) after 4 weeks from the 1st application (Figure 1C). Moreover, the change of the testing group stroked up to 9.09% while the control group was 2.33% after 4 weeks from the 2nd application. Similar to the first control group, the quantitative data of the second group displayed a less significant change after twice application (1.10, 1.04, and 1.04×10^{-1} mm) than the testing group (1.16, 1.07, and 1.02×10^{-1} mm) (Figure 2B). Also, the percentage alteration after the first application period of the testing group inclined to 7.76%, almost 1.42 times as much as the control group (5.45%). The change between the two groups incredibly increased to 2.22 folds after the second period of application, in which the testing group and control group possessed 12.07% and 5.45%, respectively (Figure 2C).

Consistent with the others, the comparison of the third control group Hydront Inj and testing group ULTRACOLS manifested a coherent result (Figure 3). As shown in Figure 3B, the skin texture

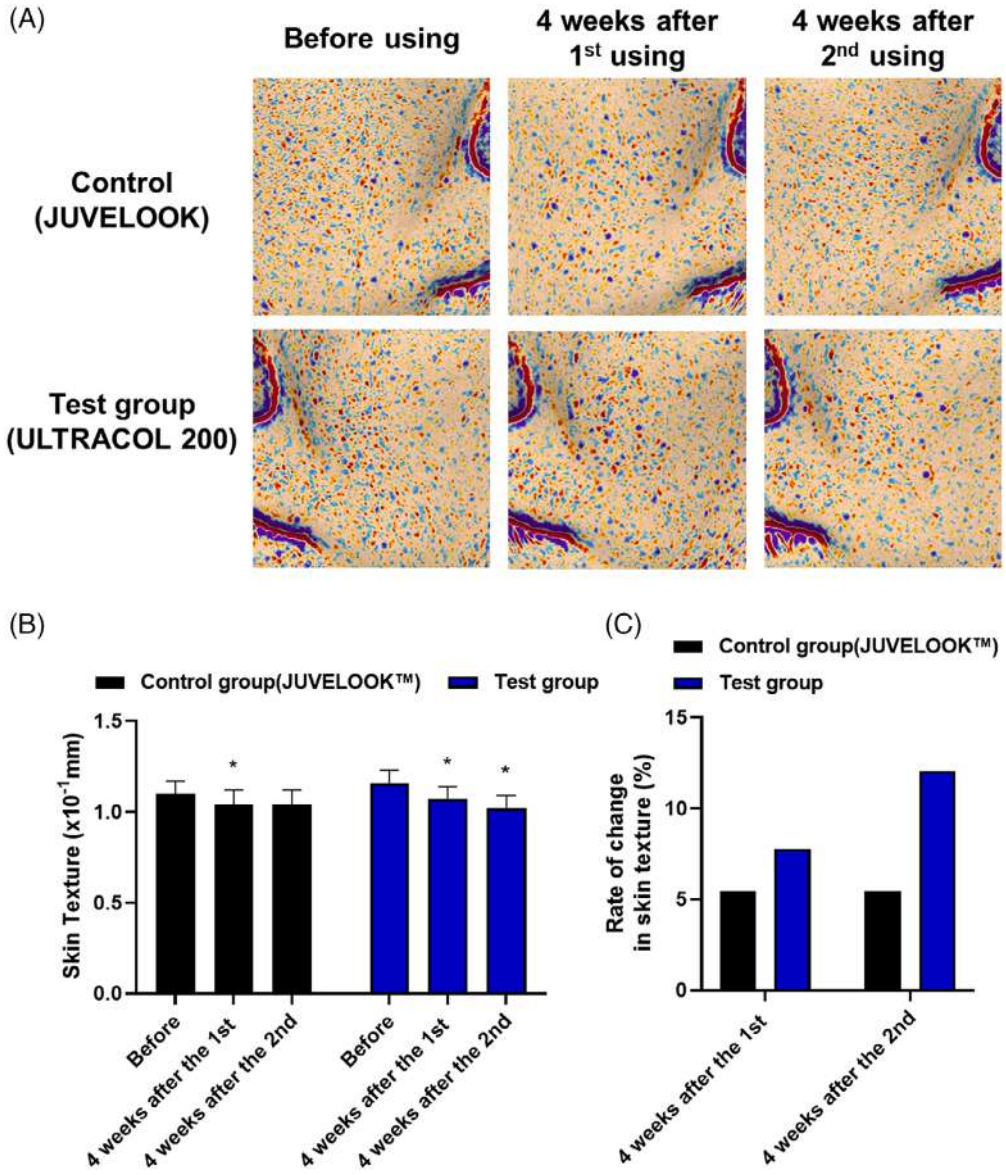


FIGURE 2 Illustrative images of the donor, captured using Antera 3D CS (Miravex Limited, Ireland). Panel (A) showcases the improvement in skin texture, while Panel (B) and (C) demonstrate quantitative analyses of skin texture measurement and the rate of change in skin texture, respectively (Mean ± SEM, $^*p < 0.05$, $n = 10$).

area when applying the ULTRACOL200 4 weeks after 1st and 2nd treatment diminished (1.18, 1.08 to 1.05 × 10^{-1} mm) while the control group showed almost no difference after twice treatment. Additionally, the improvement percentage of ULTRCOL200 after both treatment periods was noteworthily heightened compared to the control Hydront Inj.

3.2 | Effect of ULTRACOL200 on boosting skin volume and reducing wrinkle depth (sunken area)

The experimental process for the evaluation of reduction in sunken skin volume (wrinkle depth) was conducted simultaneously. The sunken skin volume was subsequently assessed and analyzed by ANTERA 3D in three periods of time: before the application of the fillers, 4 weeks after the 1st application, and 4 weeks after the 2nd application (Figure 4A, 5A, 6A). The measured sunken skin volume was presented in yellow areas.

The qualitative analysis in Figure 4B assessed through visualization in Figure 4A manifested that the sunken volume of the testing group considerably decreased right after the 1st application (2.59 to 2.18 mm^3) and continued to reduce drastically after the 2nd application (1.98 mm^3). On the contrary, the results of the control group REJURAN slightly altered (2.42, 2.21, and 2.19 mm^3) after twice applications, showing less effectiveness in reducing sunken volume than the testing group. To verify these findings, the change rate in improving sunken skin volume was calculated (Figure 4C). The graph demonstrated an 8.68% change in the control group (REJURAN) and a 15.83% change in

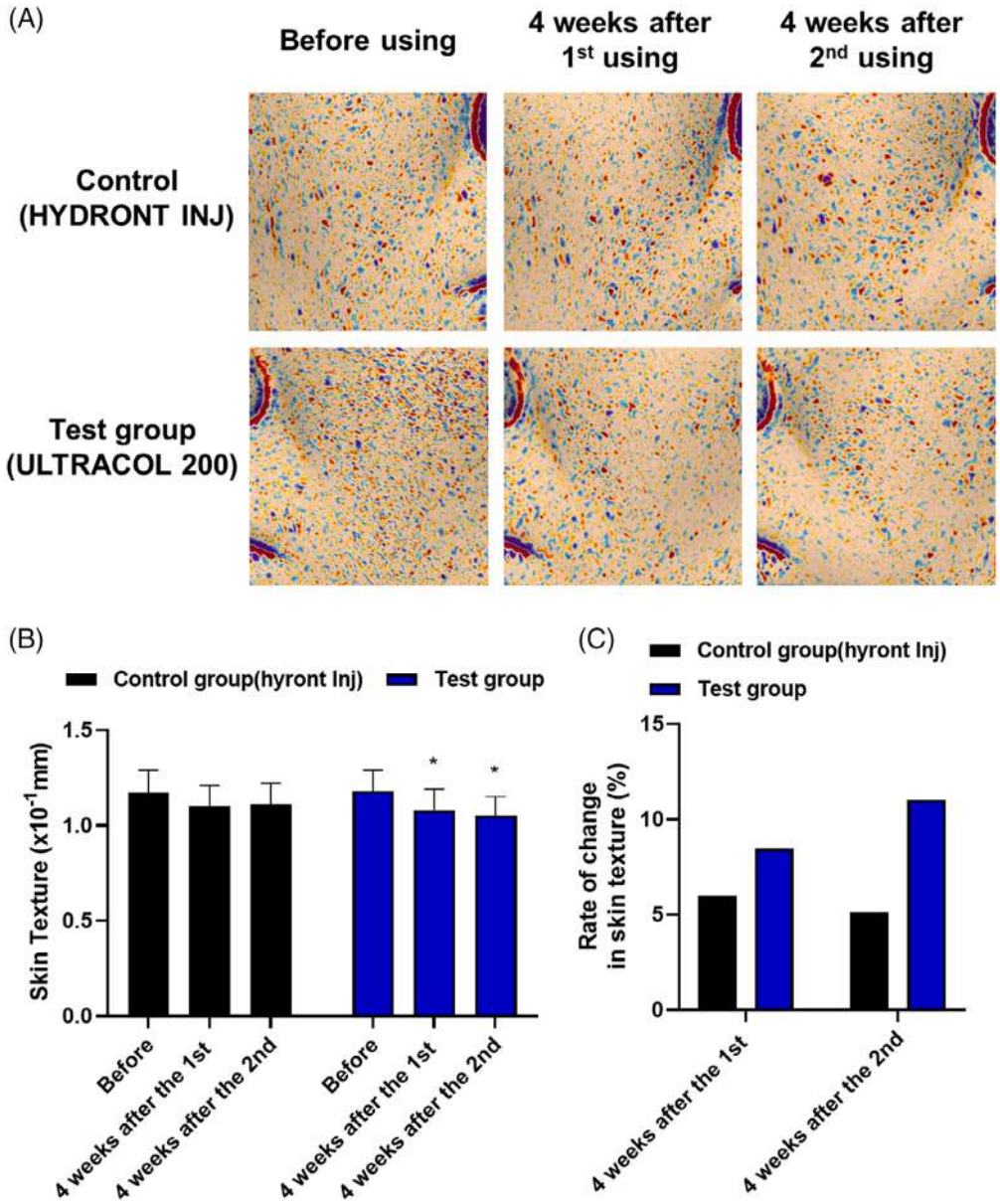


FIGURE 3 Illustrative images of the donor, captured using Antera 3D CS (Miravex Limited, Ireland). Panel (A) showcases the improvement in skin texture, while Panel (B) and (C) demonstrate quantitative analyses of skin texture measurement and the rate of change in skin texture, respectively. (Mean ± SEM, $^{*}p < 0.05$, $n = 10$).

the test group (ULTRACOL200) 4 weeks after both products were initially applied. Moreover, 4 weeks following the second application, the control group (REJURAN) showed a 9.50% change, whilst the testing group (ULTRACOL200) showed a stunning 23.55% change, illustrating a substantial difference between the two products.

As shown in Figure 5B, though through initial injection, the control product JUVELOOK demonstrated a significant decrease in sunken volume, the data between 1st and 2nd applications fluctuated (1.81, 1.57, and 1.59 mm^3) while the results of the testing group consistently showed declines (1.83, 1.60, and 1.44 mm^3). Additionally, when assessed in terms of percentages, the alteration in the improvement of skin volume of the testing group significantly manifested an increase of 1.75 times as much as the control group.

Resembling the trends in two other groups, the control group Hydront Inj was depicted in Figure 6 to possess a substantial diminution in sunken volume after 4 weeks initially; the data during the twice applications exhibited variations (1.95, 1.74, and 1.80 mm^3), whereas the ULTRACOL200 group coherently showed decreases (1.94, 1.65, and 1.50 mm^3). The drastic difference between the two groups after 2nd application was almost 2.9 folds which suggested the considerable effectiveness of ULTRACOL200 in supporting skin augment (Figure 6C).

Vectra and PRIMOS LF were utilized to overall capture pictures at different angles to simultaneously verify and emphasize the findings, as depicted in Figure 7. Overall, the ULTRACOL200 provided a more radiant and glossier appearance compared to other control groups.

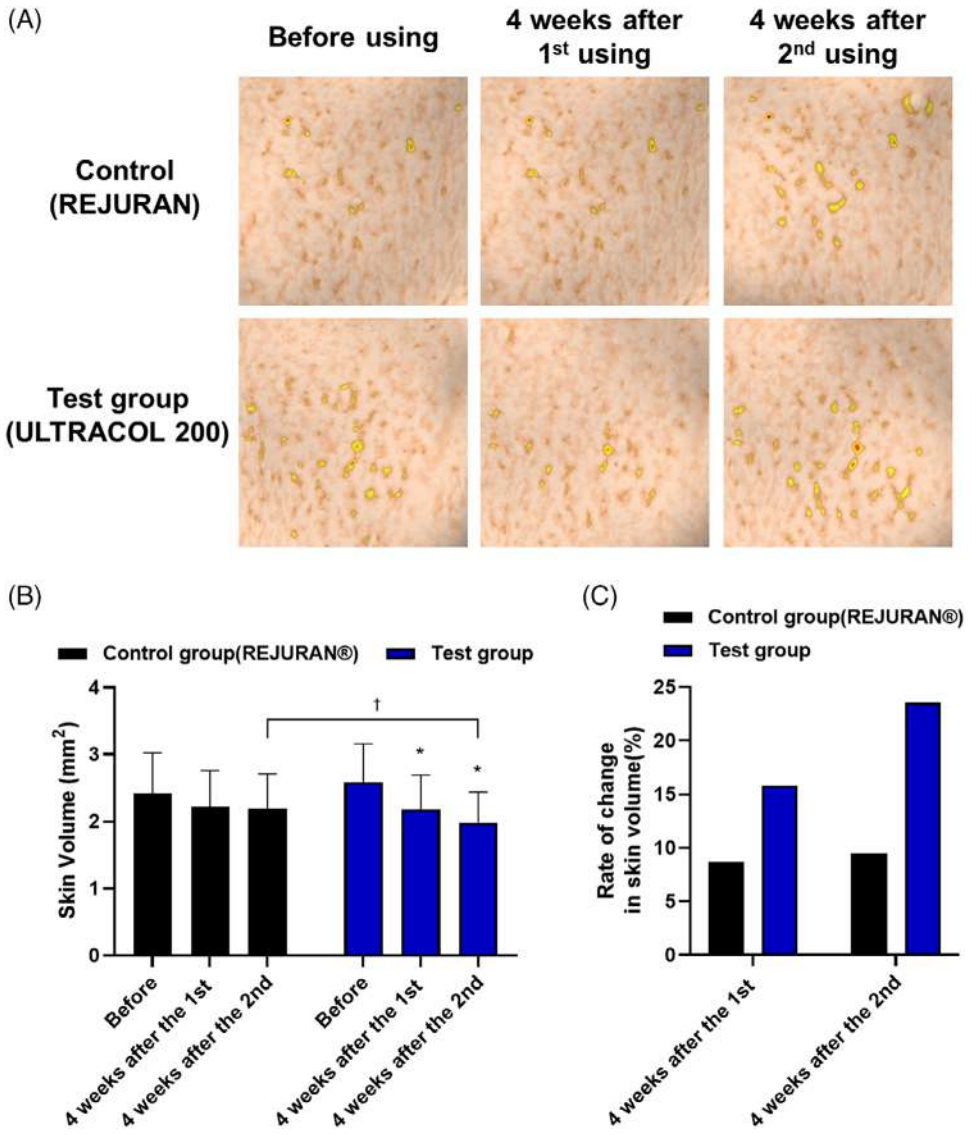


FIGURE 4 Illustrative pictures of the donor captured with Antera 3D CS (Miravex Limited, Ireland). Panel (A) depicts the enhancement in skin volume, (B) quantitative analysis of skin volume measurement, (C) quantitative analysis of rate change in skin volume (Mean ± SEM, $^*p < 0.05$, $n = 10$).

3.3 | A subjective survey of participants to evaluate the efficacies of ULTRACOL200 in enhancing skin issues

To evaluate the efficacy of ULTRACOL200 in enhancing cutaneous issues compared to other commercial products, subjective questionnaires were provided to participants (Figure 8). The questionnaires were surveyed at different periods: 4 weeks after the 1st application and 4 weeks after the 2nd application of the product to maintain consistency in assessment throughout the research. The list of questions for surveyswere listed in Table 1.

Figure 8A depicted the responses of participants after 4 weeks of initially ULTRACOL200 injected, which overall manifested positive feedback in enhancing skin volume, elasticity, skin tone, and radiance. Figure 8B illustrated the reactions of satisfaction of the participants after 4 weeks following the 2nd application of ULTRACOL200. After the 2nd application of the products, almost all the characterized and analyzed dermatological factors from the participants exhibited considerable positivity in feedback. A large proportion of research participants (about 61% to 87%) responded favorably to all examined characteristics. Noticeably, the responses of the improvement in skin texture and skin volume remarkably inclined after the 2nd application of the testing product (48.39% to 87.10%), showing an approximate value twice as much as the 1st application. Moreover, the improvement in skin pores after the 2nd application of the products drastically enhanced from 51.61% to 74.19%, which implied an almost 1.5 folds increase, illustrating the noteworthy impact of the product in cutaneous enhancement.

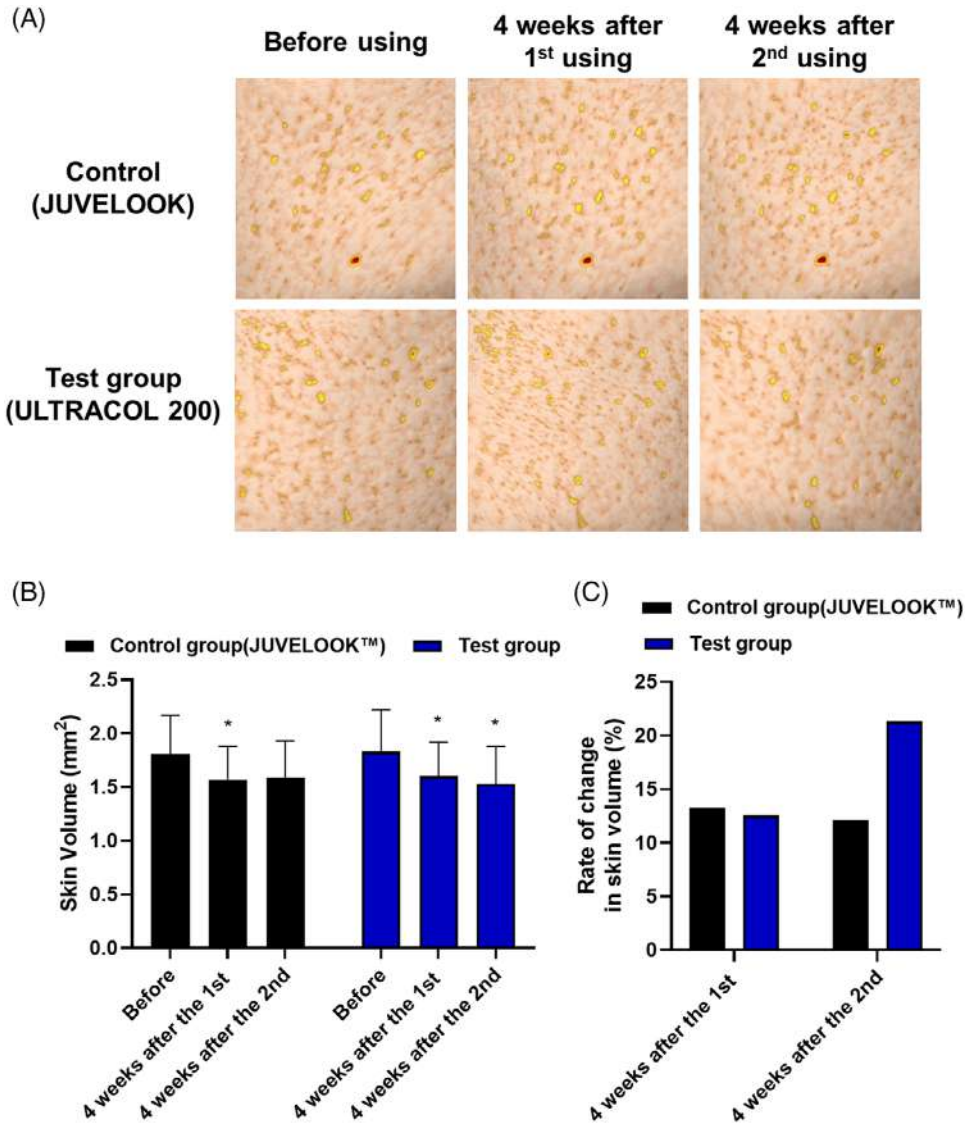


FIGURE 5 Illustrative pictures of the donor captured with Antera 3D CS (Miravex Limited, Ireland). Panel (A) depicts the enhancement in skin volume, (B) quantitative analysis of skin volume measurement, (C) quantitative analysis of rate change in skin volume Each group underwent analysis with a sample size of $n = 10$.

4 | DISCUSSION

Skin volume loss to deep drains and wrinkles was resulted in cutaneous aging, which is caused by intrinsic and extrinsic factors.[24] Nasolabial fold wrinkles emerge as the most prominently evident marks of aging from nose to lower cheek areas, significantly reducing the facially youthful look. Non-invasive methods have been developed to improve nasolabial folds through cutaneous repairs including laser treatment, micro-needling, and dermal filler. For instance, Mohammad et al. effectively reduced nasolabial fold areas and depths using a combination of sterile lifting fiber and laser, showing satisfactory results 3 months after the treatment.[25] Though laser has been considered a golden alternative for direct treatment of nasolabial fold, dermal filler injection for skin rejuvenation has also become an evolving and emerging method that boosts facial rejuvenation rapidly and immediately.[26] Commercial trending fillers comprise in hyaluronic acid (HA) combined with carriers to enhance its stability against fast hydrolysis properties.[27,28] However, those crosslinked HA fillers display a weak tensile strength compared to other filler, which is less supportive scaffold under the skin.[29,30] Therefore, new biodegradable filler materials such as PCLC, PLC (polycaprolactone), and PDO (polydioxanone) have emerged.

PDO exhibits excellent flexibility and tensile strength, accompanied by biocompatibility and minimal inflammation, which has a 12-week retention time in the body and does not interfere with the activities of macrophages and white blood cells.[31,32]Therefore, PDO has been studied for its safety in pre-clinical and clinical trials in vitro or in humans as implant devices such as sutures and stents. PDO-based polymer materials are entirely absorbed in vitro after 3 months to 4 months and in the human body after 6 to 7 months.[33] Hence, PDO could be utilized as

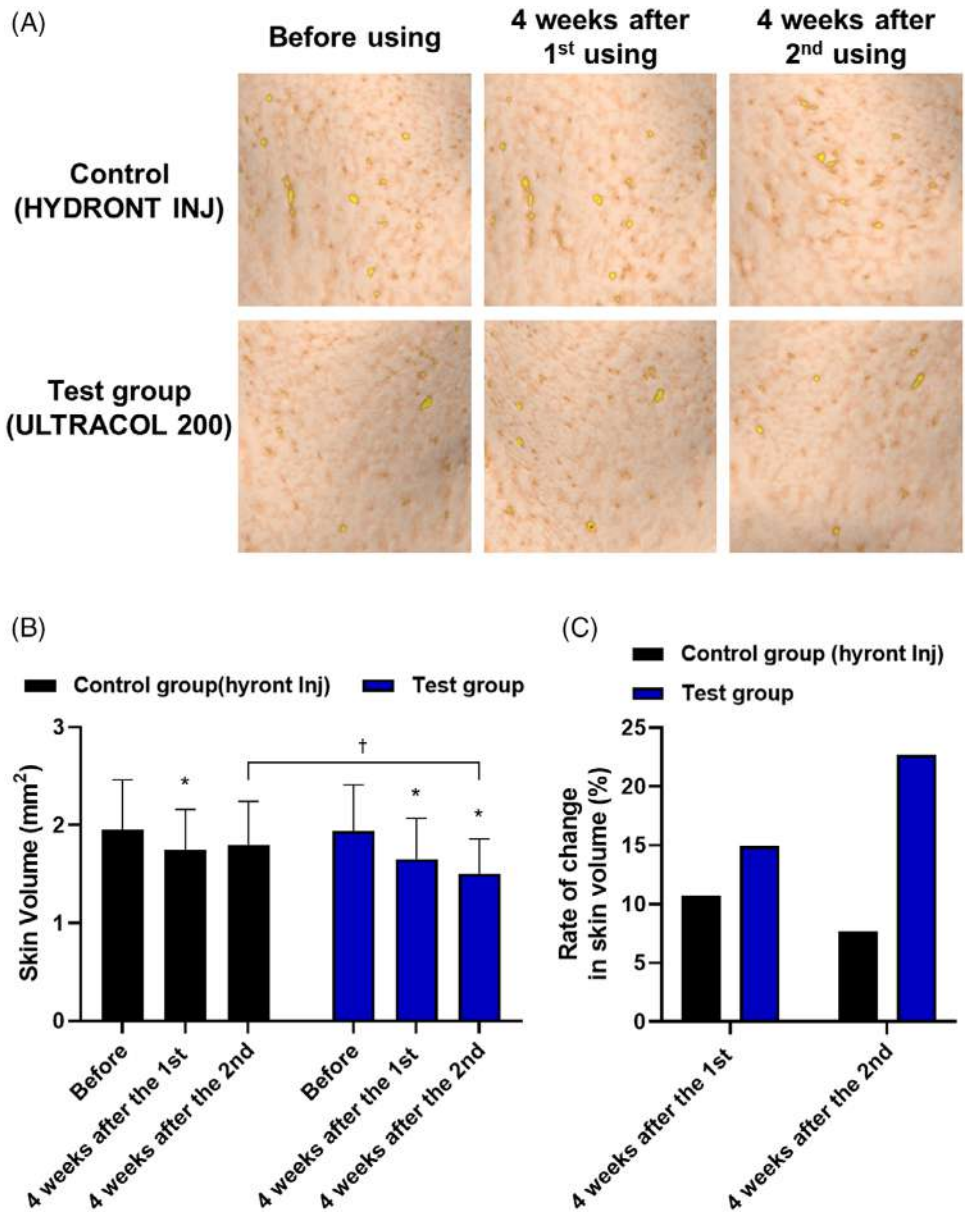


FIGURE 6 Illustrative pictures of the donor captured with Antera 3D CS (Miravex Limited, Ireland). Panel (A) depicts the enhancement in skin volume, (B) quantitative analysis of skin volume measurement, (C) quantitative analysis of rate change in skin volume (Mean ± SEM, $^{*}p < 0.05$, $n = 10$).

an injectable filler to elevate and escalate the cutaneous areas such as the neck and facial creases that help maintain a youthful look. Though PDO has been well-known as a lifting thread, PDO dermal fillers may offer benefits such as easy manipulation, brief procedural duration, and precise volume enhancement, which creates a natural appearance than PDO threads.

In this study, PDO and SCMC were combined to form the filler matrix to create the basis of the ULTRACOL200 filler. It could be observed that after 4 weeks of first applying ULTRACOL200, the efficacy in cultivating a rejuvenating cutaneous look demonstrated through the decrease of skin texture and sunken areas measured by ANTERA 3D significantly increased compared to the commercialized products (REJURAN, JUVELOOK, Hydront Inj). Moreover, after 4 weeks of 2nd application of ULTRACOL200, the indicator of cutaneous aging, as mentioned, remarkably declined (Figure 2–6). The results of the research could be ascribed to the characteristic of PDO that has been reported to be a neo-collagen material that improves the elasticity, roughness of skin through collagen production triggered by fibroblasts to scaffold dermal layers. Our previous study on mice demonstrated a considerable increase in collagen after 6 months by Sirius red staining of injection, and the study also manifested an obvious visualization of increased epidermal thickness.[23] In addition, the SCMC gel carrier is progressively absorbed by macrophages after injection of PDO filler over several weeks leading to the substitution of collagen formation that also allows vascular cells and fibroblasts by PDO to replace the loss by SCMC. Therefore, it could be concluded that

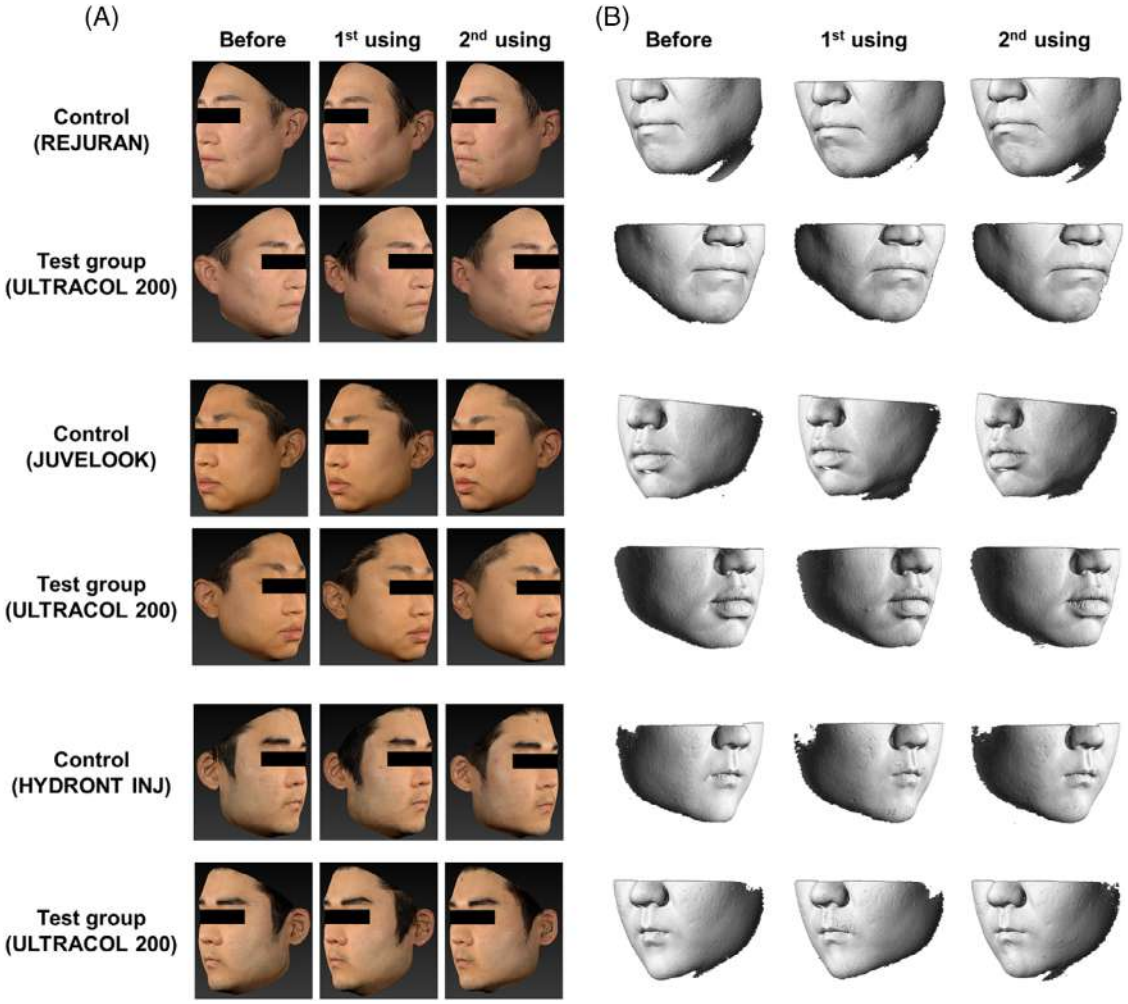


FIGURE 7 Showcase illustrative pictures of the donor, captured through Vectra and PRIMOS LF imaging systems. Panel (A) displays the image acquired via Vectra for skin volume analysis, while panel (B) presents the image processed using PRIMOS LF, also for skin volume assessment. Both devices offer visualizations of skin volume.

TABLE 1 Questions to evaluate the effectiveness of ULTRACOL200 4 weeks after 1st and 2nd·

Question number	Question content
Q1.	Did your skin feel smoother after the application of the ULTRACOL200?
Q2	Did you perceive an improvement in skin volume after applying the ULTRACOL200?
Q3.	Did you experience an enhancement in skin elasticity after applying the ULTRACOL200?
Q4.	Did you observe an enhanced deep skin elasticity after applying the ULTRACOL200?
Q5.	Did your skin experience increased moisturization and firmness after applying the ULTRACOL200?
Q6.	Did you notice a reduction in internal skin dryness after applying the ULTRACOL200?
Q7.	Did you observe an improvement in skin tone after applying the ULTRACOL200?
Q8.	Did you notice an enhancement in skin radiance after applying the ULTRACOL200?
Q9.	Did you observe increased transparency on your skin after the application of the m ULTRACOL200?
Q10.	Did you perceive a positive effect on skin pore improvement after applying the ULTRACOL200?
Q11.	Did you observe an enhancement in skin density after applying the ULTRACOL200?
Q12.	Did you feel an overall improvement in your skin's condition improved after the ULTRACOL200?
Q13.	Overall, were you satisfied with the procedure?
Q14.	Would you recommend this procedure to others?

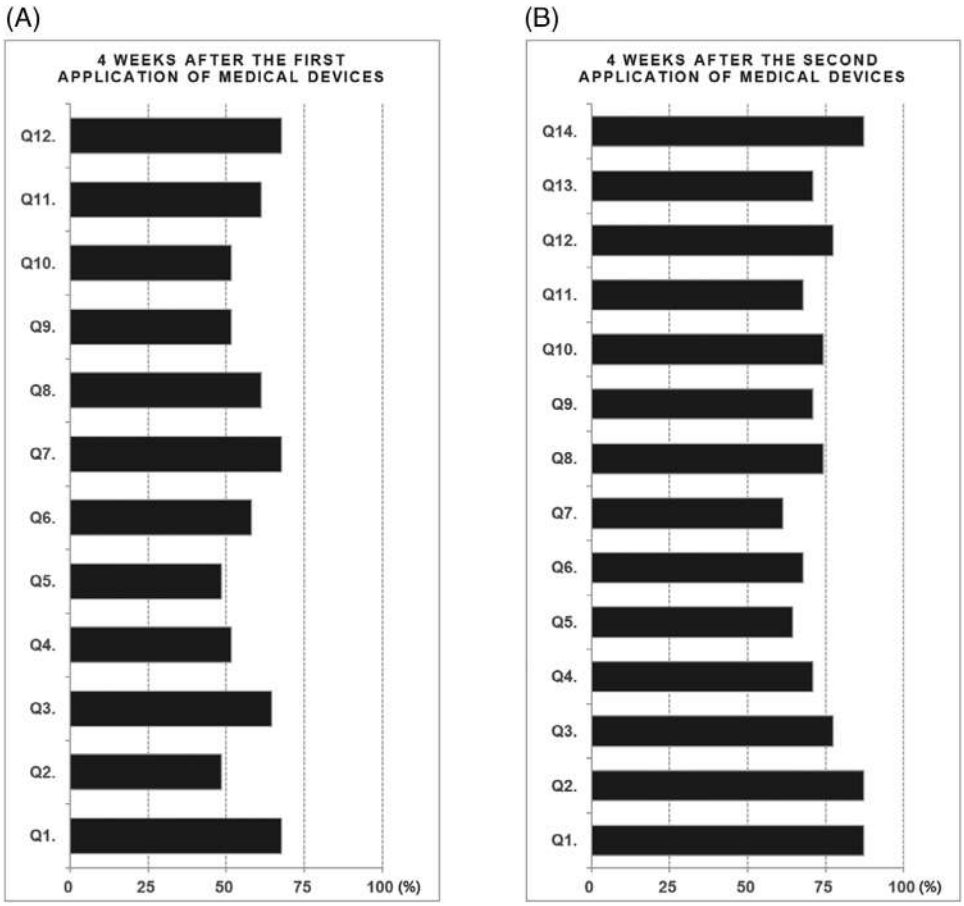


FIGURE 8 Evaluative survey analysis by participants when applying ULTRACOL200 with (A) The results conducted 4 weeks after the 1st injection, (B) The results conducted after 4 weeks of the 2nd injection.

ULTRACOL200 is a collagen-promoting filler that corrects wrinkles that consequently stimulate the manufacture and repair of collagen to other connective tissue.

Sensory reactions of the skin have been used to identify cutaneous issues, and many devices have been utilized to evaluate the functions of the skin and detect skin problems.[34] ANTERA 3D is the most recent specialized medical skin imaging and analysis equipment, which analyzes shadow and light reflectance to produce a three-dimensional color image of the skin surface for rapid, simple, and accurate analysis and measurement of wrinkles and texture.[35] PRIMOS and VECTRA were also used to provide comprehensive images to confirm the efficacy of ULTRACOLL200 in reducing texture and wrinkles, giving a more radiant and glossy look when applied to human skin. In our study, subjective questionnaires are based on self-evaluation of customers trials after using the ULTRACOL200 products. The survey evaluation of the ULTRACOL200's effectiveness revealed favorable responses from the participants, which was implied by a substantial number of positive replies on evaluated criteria, indicating ULTRACOL200 had a beneficial influence on many areas of skin improvement.

5 | CONCLUSION

In conclusion, this study demonstrated the efficacy of ULTRACOL200 in enhancing the most noticeable cutaneous aging issues: skin texture and wrinkle depth. Coherent imaging analysis by utilizing ANTERA 3D exhibited considerable enhancements in the test groups compared to the control groups. Particularly, the responses of the participants pitched various positivity in improving cutaneous problems after injecting ULTRACOL200 twice, which emphasized favorable influences on various aspects of skin improvement. Consequently, ULTRACOL200 might be considered a potential and effective medical device that impressively enables skin rejuvenation and resurfacing. To validate and elaborate these findings, further progression enclosing larger sample sizes and extended subsequent periods will be conducted in the future.

ACKNOWLEDGMENTS

This study was supported by Ultra V Co., Ltd.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing financial interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

This study has been approved by the Ethics Committee of the Korea Skin Clinical Research Center, H&Bio Corporation, Seongnam, Korea.

ORCID

Chan Yeong Heo https://orcid.org/0000-0001-9003-7365

REFERENCES

1. Chaudhary M, Khan A, Gupta M. Skin ageing: pathophysiology and current market treatment approaches. *Curr Aging Sci*. 2020;13(1):22-30. doi:10.2174/1567205016666190809161115
2. Zhang S, Duan E. Fighting against skin ageing. *Cell Transplant*. 2018;27(5):729-738. doi:10.1177/0963689717725755
3. Baumann L. Skin ageing and its treatment. *J Pathol*. 2007;211(2):241-251. doi:10.1002/path.2098
4. Wong QYA, Chew FT. Defining skin aging and its risk factors: a systematic review and meta-analysis. *Sci Rep*. 2021;11(1):22075. doi:10.1038/s41598-021-01573-z
5. Krutmann J, Schikowski T, Morita A, Berneburg M. Environmentally-Induced (Extrinsic) skin aging: exposomal factors and underlying mechanisms. *J Invest Dermatol*. 2021;141(4):1096-1103. doi:10.1016/j.jid.2020.12.011
6. Naidoo K, Birch-Machin M. Oxidative stress and ageing: the Influence of environmental pollution, sunlight and diet on skin. *Cosmetics*. 2017;4(1):4. doi:10.3390/cosmetics4010004
7. Krutmann J, Bouloc A, Sore G, Bernard BA, Passeron T. The skin aging exposome. *J Dermatol Sci*. 2017;85(3):152-161. doi:10.1016/j.jdermsci.2016.09.015
8. Cho C, Cho E, Kim N, et al. Age-related biophysical changes of the epidermal and dermal skin in Korean women. *Ski Res Technol*. 2019;25(4):504-511. doi:10.1111/srt.12679
9. Li K, Meng F, Li YR, et al. Application of nonsurgical modalities in improving facial aging. Isola G, ed. *Int J Dent*. 2022;2022:1-18. doi:10.1155/2022/8332631
10. Alfeky H, Helmy Y. Nonsurgical facial rejuvenation: common methods in practice. *Al-Azhar Assiut Med J*. 2018;16(1):1-5. doi:10.4103/AZMJ.AZMJ_49_17
11. Grillo R, Borba AM, Lima APCB, Pitta MC, Veronesi R, Jodas CRP. Use of non-surgical aesthetic refinement after orthognathic surgery: case studies. *J Taibah Univ Med Sci*. 2022;17(2):320-325. doi:10.1016/j.jtumed.2021.08.006
12. Salvatore L, Natali ML, Brunetti C, Sannino A, Gallo N. An update on the clinical efficacy and safety of collagen injectables for aesthetic and regenerative medicine applications. *Polymers*. 2023;15(4):1020. doi:10.3390/polym15041020
13. Salvioni L, Morelli L, Ochoa E, et al. The emerging role of nanotechnology in skincare. *Adv Colloid Interface Sci*. 2021;293:102437. doi:10.1016/j.cis.2021.102437
14. Wongprasert P, Dreiss CA, Murray G. Evaluating hyaluronic acid dermal fillers: a critique of current characterization methods. *Dermatol Ther*. 2022;35(6). doi:10.1111/dth.15453
15. Salti G, Rauso R. Facial rejuvenation with fillers: the dual plane technique. *J Cutan Aesthet Surg*. 2015;8(3):127. doi:10.4103/0974-2077.167264
16. Teixeira S, Eblagon KM, Miranda F, R Pereira MF, Figueiredo JL. Towards controlled degradation of poly(lactic) acid in technical applications. *C*. 2021;7(2):42. doi:10.3390/c7020042
17. Martins JA, Lach AA, Morris HL, Carr AJ, Mouthuy PA. Polydioxanone implants: a systematic review on safety and performance in patients. *J Biomater Appl*. 2020;34(7):902-916. doi:10.1177/0885328219888841
18. Adhikari KR, Stanishevskaya I, Caracciolo PC, Abraham GA, Thomas V. Novel Poly(ester urethane urea)/Polydioxanone Blends: electrospun fibrous meshes and films. *Molecules*. 2021;26(13):3847. doi:10.3390/molecules26133847
19. Lots TCC. Effect of PDO facelift threads on facial skin tissues: an ultrasonographic analysis. *J Cosmet Dermatol*. 2023;22(9):2534-2541. doi:10.1111/jocd.15761
20. Kruglikov IL. Neocollagenesis in non-invasive aesthetic treatments. *J Cosmet Dermatological Sci Appl*. 2013;03(01):1-5. doi:10.4236/jcdsa.2013.31A001
21. Kwon T, Han SW, Yeo IK, et al. Biostimulatory effects of polydioxanone, poly-d, l lactic acid, and polycaprolactone fillers in mouse model. *J Cosmet Dermatol*. 2019;18(4):1002-1008. doi:10.1111/jocd.12950
22. Dalton B, Bhagabati P, De Micco J, Padamati RB, O'Connor K. A review on biological synthesis of the biodegradable polymers polyhydroxyalkanoates and the development of multiple applications. *Catalysts*. 2022;12(3):319. doi:10.3390/catal12030319
23. ZHOU S-Y, KANG SM, GU YJ, et al. Bio-characteristics and efficacy analysis of biodegradable poly dioxanone dermal filler in a mouse model and humans. *In Vivo*. 2023;37(3):1093-1102. doi:10.21873/invivo.13184
24. Bravo B, Correia P, Gonçalves Junior JE, Sant'Anna B, Kerob D. Benefits of topical hyaluronic acid for skin quality and signs of skin aging: from literature review to clinical evidence. *Dermatol Ther*. 2022;35(12). doi:10.1111/dth.15903
25. Nilforoushzadeh MA, Heidari-Kharaji M, Fakhim T, et al. Efficacy evaluation of endolift laser for treatment of nasolabial folds and marionette lines. *Ski Res Technol*. 2023;29(10). doi:10.1111/srt.13480
26. Muhn C. The evolving role of hyaluronic acid fillers for facial volume restoration and contouring: a Canadian overview. *Clin Cosmet Investig Dermatol*. 2012:5:147-158. doi:10.2147/CCID.S30794
27. Fallacara A, Baldini E, Manfredini S, Vertuani S. Hyaluronic acid in the third millennium. *Polymers*. 2018;10(7):701. doi:10.3390/polym10070701
28. La Gatta A, Schiraldi C, Papa A, De Rosa M. Comparative analysis of commercial dermal fillers based on crosslinked hyaluronan: physical characterization and in vitro enzymatic degradation. *Polym Degrad Stab*. 2011;96(4):630-636. doi:10.1016/j.polymdegradstab.2010.12.025
29. Falcone SJ, Berg RA. Crosslinked hyaluronic acid dermal fillers:a comparison of rheological properties. *J Biomed Mater Res Part A*. 2008;87A(1):264-271. doi:10.1002/jbm.a.31675
30. Béduer A, Genta M, Kunz N, et al. Design of an elastic porous injectable biomaterial for tissue regeneration and volume retention. *Acta Biomater*. 2022;142:73-84. doi:10.1016/j.actbio.2022.01.050
31. Gollapudi S. Safety and efficacy of polydioxanone nano-fibers as anti-inflammatory agents. *J Nanomedine Biotherapeutic Discov*. 2014;04(02). doi:10.4172/2155-983X.1000127
32. Oh S, Lee JH, Kim HM, et al. Poly-L-Lactic acid fillers improved dermal collagen synthesis by modulating M2 macrophage polarization in aged animal skin. *Cells*. 2023;12(9):1320. doi:10.3390/cells12091320
33. Zhao F, Sun J, Xue W, et al. Development of a polycaprolactone/poly(p-dioxanone) bioresorbable stent with mechanically self-reinforced

structure for congenital heart disease treatment. *Bioact Mater*. 2021;6(9):2969-2982. doi:10.1016/j.bioactmat.2021.02.017

34. Połap D, Winnicka A, Serwata K, Kęsik K, Woźniak M. An intelligent system for monitoring skin diseases. *Sensors*. 2018;18(8):2552. doi:10.3390/s18082552
35. Anqi S, Xiukun S, Ai'e X. Quantitative evaluation of sensitive skin by ANTERA 3D combined with GPSkin barrier. *Ski Res Technol*. 2022;28(6):840-845. doi:10.1111/srt.13213

How to cite this article: Giang NN, Kim HJ, Chien PN, et al. An evaluation of the effectiveness of 'ULTRACOL 200' in enhancing nasolabial fold wrinkles through cutaneous repair. *Skin Res Technol*. 2024;30:e13679. https://doi.org/10.1111/srt.13679