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USE OF CALCIUM HYDROXYAPATITE IN COMBATING FACIAL AGING

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INTRODUCTION

Aging is a dynamic and inevitable process that, over time, causes the appearance of visible physical signs such as wrinkles, sagging, changes in texture, and decreased skin elasticity, a consequence of the progressive decrease in collagen and elastin throughout life (SUMODJO et al, 2023). These signs are often seen as a lack of beauty in the eyes of society (SUMODJO et al, 2023).

Dissatisfaction with one's physical image is associated with negative thoughts that individuals, especially young people, have about their bodies (WALKER, 2019). This dissatisfaction can be influenced by the standards of beauty imposed by social media and/or bullying, which, as a consequence, lead people to express a huge desire for both surgical and non-surgical aesthetic changes (WALKER, 2019).

According to a survey conducted by the Brazilian Society of Plastic Surgery (SBCP), there has been a 390% increase in searches for non-surgical aesthetic procedures since 2020, and Brazil is the second country that performs the most aesthetic procedures, behind only the United States (MS TRANSPARENTE, 2022).

In recent years, the field of aesthetics has been offering solutions that promise to reduce the impacts of the aging process (TORRES et al, 2022). Aesthetic procedures such as botulinum toxin application, hyaluronic acid filling, collagen biostimulator, etc., guarantee consumers a more youthful appearance for an extended period (TORRES et al, 2022).

This study aims to analyze the potential of calcium hydroxyapatite as a therapeutic technique that is biocompatible with the human body and effective in combating the physical signs of facial aging.

SKIN

Human skin tissue is composed of the epidermis, dermis, and hypodermis, providing a functional barrier that protects organs and tissues from environmental pollution, chemicals, temperature changes, and microorganisms (PARK, 2022).

The epidermis is the outermost layer, acting as a protective barrier whose main function is to control water loss from the body. The epidermis has 4 or 5 layers, depending on the region of the body, which are: the basal layer, the spinous layer, the granular layer, the lucid layer, and the stratum corneum (PARK, 2022).

The dermis is composed of two layers, the papillary layer and the reticular layer. The papillary layer is thinner and more superficial, composed of loose connective tissue and containing dermal papillae. Unlike the papillary layer, the reticular layer is deeper and thicker, composed of dense, unmodeled connective tissue, rich in collagen and elastic fibers (BRAZILIAN SOCIETY OF DERMATOLOGY).

The dermis is responsible for the flexibility, elasticity, and firmness of the skin, in addition to providing support to the epidermis, vascular network, and nerves (BRAZILIAN SOCIETY OF DERMATOLOGY).

Finally, the hypodermis is the third layer of the skin, formed by fat, blood vessels, and nerves, providing a reservoir of progenitor cells and energy. In addition, it is associated with endocrine and paracrine signaling (PARK, 2022).

FACIAL AGING

Aging is divided into two types: intrinsic and extrinsic. Intrinsic aging is caused by changes that occur from birth and is caused by falling hormone levels, aging of the nervous system, heredity, etc. (CANTEIRO et al, 2022).

Extrinsic aging, on the other hand, is caused by external factors such as smoking, al-

coholism, and, above all, solar radiation, which causes cellular damage. The damage caused by ultraviolet solar radiation (UVA and UVB) causes premature collagen degradation, damage to nuclear DNA and mitochondr , and activation of abnormal metabolic pathways, which leads to a chronic and cumulative inflammatory process (CANTEIRO et al, 2022).

Aging intrinsically, the skin thins as the dermis atrophies, thus increasing the rate of collagen degradation and decreasing the rate of collagen synthesis. Between the ages of 40 and 50, the skin loses elasticity as the network of elastic fibers disintegrates (SWIFT et al, 2021).

In addition to increased degradation and decreased collagen production, extrinsically aged dermis undergoes cellular elastosis, i.e., an increase in the quantity and thickness of abnormal elastic fibers, causing damage and leading to degradation of the elastic fiber network (SWIFT et al, 2021).

There are other factors that affect the physiology and aesthetics of the skin, such as a reduction in cell numbers and function, a decrease in hormones, and changes in melanocytic and Langerhans cells (SWIFT et al, 2021).

Age-related facial changes occur in a three-dimensional, integrated, and codependent manner in the soft tissues, skin, and bone. Although each layer of the skin undergoes specific reactions, there is a practical relationship between them, where the most superficial structures of the skin depend on the stability of the deeper layers (SWIFT et al, 2021).

The facial bones are the structural foundation of the soft tissues, but there is a significant loss of structure with advancing age, leading to a loss of support, fat, and muscle (SWIFT et al, 2021).

The fat compartments of the face are divided into superficial and deep, according to their relationship with the SMAS (musculoaponeurotic system). Superficial fat is present in the cheeks, forehead, jowls, and periorbital space (SWIFT et al, 2021).

Deep fat compartments include medial cheek fat, buccal fat, suborbicular fat, and retro-orbicular fat. Deep fats are immobile because they are firmly attached to the bone, helping to support and contour the face (SWIFT et al, 2021).

Bone resorption reduces the projection of areas such as the mandible, maxilla, and malar region, leading to a decrease in the support of soft tissues, such as fat. The loss of facial fat results in sagging, especially in areas where deep fat is located, as it is responsible for contour and volume (YANG et al, 2021).

Aesthetically, the loss of bone structure and fat leads to a tired, aged, and unbalanced appearance. The balance between the two is extremely important to maintain the appearance of a harmonious and youthful face (YANG et al, 2021).

CALCIUM HYDROXYAPATITE

Calcium hydroxyapatite or CaHA, with the chemical formula $Ca_{10}(PO_4)_6(OH)_2$, is a calcium phosphate-based mineral, the main mineral component of bones and teeth, making it a biocompatible, biodegradable material that is absorbable by the human body (OLIVEIRA et al, 2021).

Its composition contains 30% synthetic microspheres with a diameter between 25 and 45 μm and 70% aqueous carrier gel containing sodium carboxymethylcellulose, sterile water, and glycerin (NECA et al., 2022). The mechanism of action of hydroxyapatite is divided into four phases: immediate volumization, biodegradation, cell stimulation, and finally, degradation and absorption of CaHA (NECA et al., 2022).

When injected into the deep dermis or subcutaneously, CaHA microparticles suspended in carboxymethylcellulose (CMC) gel generate an immediate filling effect, impro-

ving and volumizing the contour of the site (CAMPOS, SANTOS, 2024). After about 60 days, the body recognizes the carboxymethylcellulose gel microparticles, triggering a controlled inflammatory response leading to the recruitment of fibroblasts and macrophages (CAMPOS, SANTOS, 2024).

About 9 to 12 months after application, the CaHA particles are degraded into calcium and phosphate and subsequently eliminated by the kidneys. When used pure or slightly diluted, calcium hydroxyapatite provides immediate filling of the applied site and then formation of new tissue through neocollagenesis, elastin production, angiogenesis, and proliferation of dermal cells (DE ALMEIDA et al, 2019).

As the CMC gel is absorbed, CaHA microparticles activate fibroblasts and synthesize type III collagen (new collagen) around the gel. Then, type III collagen matures into type I collagen (mature collagen), presenting tensile strength and improving the appearance of the skin (CAMPOS, SANTOS, 2024).

Calcium hydroxyapatite is a semi-permanent filler that, when diluted, is used as a collagen biostimulator and is constantly used when the goal is functional, natural, and more harmonious aesthetic treatment (OLIVEIRA et al, 2021).

Although the FDA (Food and Drug Administration) approved CaHA in 2006 as a filler for use in nasolabial folds, it has also been used as a collagen stimulator and has shown successful clinical results over the past 14 years (OLIVEIRA et al, 2021).

In summary, the main mechanism of action of calcium hydroxyapatite is the activation of specific cells, such as fibroblasts, which are responsible for the production of collagen and several other skin proteins, resulting in the stimulation of type III collagen (SARAGOÇA et al, 2023).

COLLAGEN

From the age of 25, natural collagen production begins to gradually decline, becoming even more pronounced at the age of 40, when the body produces only 1% of the amount of collagen that was synthesized during youth (SEABRA, SILVA, 2022).

As a result, its deficiency becomes visibly noticeable, especially with the appearance of physical signs, such as lack of skin elasticity, resulting in a "melted face" appearance. In addition to the aesthetic consequences, the decrease in this protein also contributes to the emergence of possible pathologies related to its insufficiency in the body (OLIVEIRA et al, 2021).

Collagen is a fibrous protein present in 30% of the human body, found in connective tissues such as skin, joints, and bone . Collagen is composed of approximately 30% glycine, 12% proline, 11% alanine, 10% hydroxyproline, 1% hydroxylysine, and small amounts of polar and charged amino acids (OLIVEIRA et al, 2021).

The human body has 28 different types of collagen, with type I (accounting for 90% of the protein), II, III, IV, and V representing the majority present in the body (OLIVEIRA et al, 2021).

EFFECTIVENESS OF CALCIUM HYDROXYAPATITE AS A BIOSTIMULATOR

Calcium hydroxyapatite (CAHA) is a synthetic, injectable collagen biostimulator, commercially known as Radiesse, which was regulated in 2006 by the FDA for use in the treatment of wrinkles and lipoatrophy associated with the HIV virus (FEITOSA, 2021).

Since 2004, studies have shown that the effect of the CaHA biostimulator is secondary to a controlled inflammatory process that generates a fibroblastic reaction and, after the reaction, there is a replacement of the carbo-

xymethylcellulose gel by type I collagen deposits, which is directly associated with skin improvement (DE ALMEIDA et al., 2019).

It has been observed that CaHA produces more type I collagen, elastin, and greater fibroblast proliferation after 7 months of application compared to hyaluronic acid (DE ALMEIDA et al, 2019).

Radiesse must be diluted for application as a biostimulator, with a 1:1 dilution being most recommended, i.e., 1 part calcium hydroxyapatite to 1 part saline solution, for better use of the product (DE ALMEIDA et al, 2019).

According to clinical studies, patients showed a 50% improvement in skin condition 3 months after application, and this improvement was maintained in 91% of patients after 18 months of evaluation on the face, abdomen, arms, and thighs (DE ALMEIDA et al, 2019).In 2016, Radiesse indicated the use of hyperdiluted calcium hydroxyapatite for procedures in large areas in order to avoid nodules (DE ALMEIDA et al, 2019).

Calcium hydroxyapatite is one of the most complete options among the fillers and biostimulators available on the market ( ), due to its dual action: immediate filling effect and gradual collagen stimulation. When compared to hyaluronic acid, CaHA has a greater capacity to support and stimulate fibroblasts.

When compared to poly-L-lactic acid, commercially known as Sculptra, which acts only as a biostimulator and has a discreet initial effect, CaHA stands out for its immediate filling associated with the biostimulating effect, being indicated for both facial contouring and definition as well as biostimulation.

Therefore, calcium hydroxyapatite can be considered the most strategic choice for patients seeking filling, facial rejuvenation, tissue support, and improved skin quality.

METHODOLOGY

For this review, searches were conducted in the PubMed, Web of Science, SciELO, and Google Scholar electronic databases. The terms used for the search were: biostimulator, collagen, CaHA, calcium hydroxyapatite, aging, skin, and their variations.

An exploratory reading of books, dissertations, articles, and theses was conducted. Works published between 2019 and 2025 (except laws, resolutions, ordinances, and decrees) in English and Portuguese were included.

For inclusion, studies were selected that specifically addressed calcium hydroxyapatite, collagen stimulation, and collagen types, published within an eleven-year period, with the exception of laws, ordinances, and decrees, which are older. The criteria were applied in the following order: a) investigative reading, b) eliminatory reading, c) determination of works with a theme appropriate to the research.

Investigative research found approximately 32 files, of which 20 were analyzed in full and 18 were selected for this review.

CONCLUSION

Calcium hydroxyapatite (CaHA) is one of the most efficient and versatile options among the fillers and biostimulators available in the aesthetic world. Its main advantage lies in its dual action: immediate filling and biostimulation of collagen and elastin.

CaHA induces increased cell proliferation, collagen and elastin synthesis, and angiogenesis. Compared to other biostimulators such as poly-L-lactic acid (PLLA) or polycaprolactone (PCL), CaHA has an equivalent neo-collagenesis response, but with the advantage of immediate volumizing effect.

When compared to poly-L-lactic acid, commercially known as Sculptra, which acts only as a biostimulator and has a discreet initial effect, CaHA stands out for its immediate

filling associated with the biostimulating effect, being indicated for both facial contouring and definition as well as biostimulation.

Therefore, calcium hydroxyapatite can be considered the most strategic choice for patients seeking filling, facial rejuvenation, tissue support, and improved skin quality.

REFERENCES

CANTEIRO, E. L. O.; WECKERLIN, E. R.; OLIVEU, C. A. DA S. TRATAMENTOS PARA SINAIS DE ENVELHECIMENTO FACIAL: UMA REVISÃODE LITERATURA. **Revista Magsul de Estética e Cosmética**, p. 1–26, 13 abr. 2022.

TORRES, L. O.; DUTRA, B. S. S..; REIS, L. A. dos. **Benefícios dos procedimentos estéticos que retardam o envelhecimento cutâneo na autoestima de mulheres**. Research, Society and Development, *[S. l.]*, v. 11, n. 16, p. e312111638446, 2022. DOI: 10.33448/rsd-v11i16.38446. Disponível em: https://rsdjournal.org/index.php/rsd/article/view/38446. Acesso em: 26 mar. 2025

WALKER, C. E. et al**. Effects of Social Media Use on Desire for Cosmetic Surgery among Young Women. Current Psychology**, v. 40, n. 7, p. 3355–3364, 30 abr. 2019.

MS TRASNPARENTE. **Procedimentos estéticos não cirúrgicos cresceram 390% em 2 anos**, Disponível em:<https://www.mstransparente.com.br/noticia/5414/procedimentos-esteticos-nao-cirurgicos-cresceram-390-em-2-anos?utm_source>. Acesso em: 17 abr. 2025.

OLIVEIRA, C. S. F. P. DE et al. **Hidroxiapatita de cálcio: uma revisão quanto à eficacia, segurança e imaginologia quando usado como preenchedor e como bioestimulador**. Research, Society and Development, v. 10, n. 14, p. e05101421689, 23 out. 2021.

NECA, C. S. M.; GONDIM, A. C. L. .; ROCHA, C. A. S.; SILVA, C. A. P.; SILVA, F. G. da . **O uso de bioestimuladores de colágeno a base de hidroxiapatita de cálcio**. E-Acadêmica, [S. l.], v. 3, n. 2, p. e7332237, 2022. Disponível em: https://mail.eacademica.org/eacademica/article/view/237 . Acesso em: 5 maio. 2025.

HIDROXIAPATITA DE CÁLCIO NA HARMONIZAÇÃO GLÚTEA. RECIMA21 - Revista Científica Multidisciplinar - ISSN 2675-6218, *[S. l.]*, v. 5, n. 1, p. e515414, 2024. Disponível em: https://recima21.com.br/index.php/recima21/article/view/5414. Acesso em: 5 maio. 2025.

BIOESTIMULADORES DE COLÁGENO (ÁCIDO POLILÁTICO, HIDROXIAPATITA DE CÁLCIO, POLICAPROLACTONA E POLIDIOXANONA). RECIMA21 - Revista Científica Multidisciplinar -, *[S. l.]*, v. 4, n. 1, p. e414460, 2023. Disponível em: https://recima21.com.br/index.php/recima21/article/view/4460. Acesso em: 7 maio. 2025.

SUMODJO, P. R. P. A.; SUGUIHARA, R. T.; MUKNICKA, D. P. O envelhecimento facial e a harmonização orofacial – uma revisão narrativa da literatura. **Research, Society and Development**, v. 12, n. 5, p. e15312541591–e15312541591, 15 maio 2023.

OLIVEIRA, Nayara Rosa; DA SILVA, Ivanilde Almeida; PINTO, Rafaela Rocha. **Colágeno: uma breve revisão Collagen: a brief review.** Brazilian Journal of Development, v. 7, n. 11, p. 103346-103355, 2021.

Arthur Swift, Steven Liew, Susan Weinkle, Julie K Garcia, Michael B Silberberg, **O processo de envelhecimento facial de "dentro para fora",** *Aesthetic Surgery Journal* , Volume 41, Edição 10, outubro de 2021, Páginas 1107–1119,

SEABRA, A. DE M. N.; SILVA, D. P. DA. **Bioestimulador de colágeno na harmonização facial: uma revisão de literatura**. Research, Society and Development, v. 11, n. 14, p. e426111435713–e426111435713, 1 nov. 2022.

FEITOSA, C. DE O. M. **Uso das terapias de indução de colágeno para o controle dos efeitos deletérios do envelhecimento facial: uma revisão de literatura**. repositorio.undb.edu.br, 2 dez. 2021.

DE ALMEIDA, A. T. et al. **Consensus Recommendations for the Use of Hyperdiluted Calcium Hydroxyapatite (Radiesse) as a Face and Body Biostimulatory** Agent. Plastic and Reconstructive Surgery - Global Open, v. 7, n. 3, p. e2160, mar. 2019.

YANG, C.-S. et al. **Aging Process of Lateral Facial Fat Compartments: A Retrospective Study**. Aesthetic Surgery Journal, 27 fev. 2021. Acesso em:14 agost. 2025

PARK, S. **Biochemical, structural and physical changes in aging human skin, and their relationship**. Biogerontology, v. 23, n. 3, 15 mar. 2022.

SOCIEDADE BRASILEIRA DE DERMATOLOGIA. **Conheça a pele**. Disponivel em: <https://www.sbd.org.br/cuidados/conheca-a-pele/>. Acesso em: 14 agost. 2025