

Adjuvant use of collagenase to facial soft tissues reconstruction: Case report with a six-year follow-up

Uso adjuvante de colagenase na reconstrução de tecidos moles faciais: Relato de caso com seis anos de acompanhamento

Uso adyuvante de colagenasa en la reconstrucción de tejidos blandos faciales: Reporte de caso con seis años de seguimiento

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Abstract

The facial injuries occur more frequently among young male adult, resulting from varied etiology, such as automobile accidents and interpersonal violence. The lesions predominantly affect the frontal region or the facial subunits, reaching hemiface or the entire face, with various levels of severity. This study aims to report a case of severe facial tissues injury involving hemiface and ear avulsion, including the immediate emergency treatment with suture and flap rotation, collagenase use, complementary treatments such as the use of low intensity CO2 laser, hyaluronic acid and botulin toxin. The patient had a satisfactory evolution in a six-year follow-up. Thus, a well-planned treatment for facial restorations and

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an appropriated combined therapy may bring positive results.

Keywords: Facial injuries; Soft tissue injuries; Traumatology; Collagenases.

Resumo

As lesões faciais ocorrem com maior frequência em adultos jovens do sexo masculino, resultantes de etiologia variada, como acidentes automobilísticos e violência interpessoal. As lesões afetam predominantemente a região frontal ou as subunidades faciais, atingindo a hemiface ou toda a face, com diversos graus de gravidade. Este trabalho tem como objetivo principal relatar um caso de lesão grave de tecidos moles faciais envolvendo avulsão de hemiface e orelha, incluindo o tratamento de emergência imediato com sutura e rotação de retalho, uso de collagenase e tratamentos complementares como o uso de laser de CO₂ de baixa intensidade, ácido hialurônico e toxina botulínica. O paciente apresentou evolução satisfatória em um acompanhamento de seis anos. Dessa forma, um tratamento bem planejado para reconstruções faciais e uma terapia combinada apropriada podem trazer resultados positivos.

Palavras-chave: Lesões faciais; Lesões dos tecidos moles; Traumatologia; Collagenases.

Resumen

Las lesiones faciales ocurren con mayor frecuencia en hombres adultos jóvenes, como resultado de una etiología variada, como accidentes automovilísticos y violencia interpersonal. Las lesiones afectan predominantemente la región frontal o las subunidades faciales, pudiendo comprometer la hemifacies o la cara completa, con diversos grados de gravedad. Este trabajo tiene como propósito principal reportar un caso de lesión grave de los tejidos blandos faciales con avulsión de hemifacies y oreja, incluyendo el tratamiento de emergencia inmediato con sutura y rotación de colgajo, el uso de collagenasa y tratamientos complementarios como el uso de láser de CO₂ de baja intensidad, ácido hialurónico y toxina botulínica. El paciente tuvo una evolución satisfactoria en un seguimiento de seis años. Por lo tanto, un tratamiento bien planificado para restauraciones faciales y una terapia combinada apropiada pueden traer resultados positivos.

Palabras clave: Lesiones faciales; Traumatismos de los tejidos blandos; Traumatología; Collagenasas.

1. Introduction

The facial trauma is one of the greatest challenges for the Public Health and its prevalence varies according to numerous factors, such as gender, age, socioeconomic level, as well as the mechanisms of injuries. Furthermore, due to the close relationship of the face to the skull, facial injuries increase the chances and risks of traumatic damage to the brain. (Welshhans & Hom, 2017; Paasche et al., 2024)

Lesions in the craniofacial region comprise 7% of cases in the emergency services, and from this, face lacerations and scalps reach 50% on average and affect people with the average group of 28 years. Regardless of the gender, soft tissue damages may occur in isolation or associated with additional trauma, and may be limited to superficial tissues or involve deeper structures. (Braun & Maricevich, 2017; Paasche et al., 2024)

The trauma of the facial soft tissues is the main cause of traumatic functional and esthetic sequelae. Therefore, requires the repair especially of the eyelids and periorbital region due to the risk of poor aesthetic and functional pos-surgical results although many of them may have good long-term results. (Ko et al., 2021; Demke et al., 2024)

There are numerous methods for assessing tissues conditions and the control plan must be specific to each case. The correct cleaning, debridement and irrigation, and removal of irregular edges, as well as the use of systemic antimicrobial prevent bad results such as late closure and other adverse risks, especially in immunocompromised patients. (Braun & Maricevich, 2017; Paasche et al., 2024; Tagliaferri et al., 2024)

The healing of wounds in a humid environment has already demonstrated numerous advantages when compared to the dry environment, among them the prevention of tissue dehydration, which results in cell death. In addition, accelerating angiogenesis stimulates epithelialization and the formation of granulation tissue, facilitates the removal of necrotic tissue and fibrin, and serves as a protective barrier against microorganisms, promotes pain reduction, prevents excessive fluid loss and prevents further trauma during dressing changes. Dressing can be made with ointments and oils, such as silver sulfadiazine, essential fatty acids, hydrocolloids, calcium alginate, hydrogels, activated carbon, hydro polymer adhesive, vacuum dressings and collagenase-based ointment. (Alves et al., 1970; Braun & Maricevich, 2017)

The involvement of multiple aesthetic units of the face during severe trauma requires that reconstructions be planned, considering each of these subunits, since from the scalp, forehead, periorbit, eyelids, eyebrows, lips and ear require different reconstruction techniques. (Braun & Maricevich, 2017; Welshhans & Hom, 2017; Paasche et al. 2024) This study aims to report a case of severe facial tissues injury involving hemiface and ear avulsion, including the immediate emergency treatment with suture and flap rotation, collagenase use, complementary treatments such as the use of low intensity CO2 laser, hyaluronic acid and botulin toxin.

2. Methodology

This is a qualitative study, which was made as a case report. The main objective is to describe and better understand how to manage an extensive facial wound and its indication of Collagenase. Data were collected through medical records and figures. Pertinent literature has been selected to connect these project results.

This is a descriptive research of qualitative nature and of the specific kind of a clinical case (Santini et al., 2019). The main objective is to describe and better understand how to manage an extensive facial wound and its indication of Collagenase. This article is endorsed by the Ethics Committee of Goiânia Emergency Hospital (Goiás, Brazil), and respects the guidelines and principles of CNS Resolution 466/2012, the CONEP 2018 letter and the Declaration of Helsinki. An informed consent form has been signed by the patient, authorizing the use of data and images for academic purposes.

3. Case Description

DQMS patient, 23-year-old, leucoderma, victim of a car accident, assisted by SAMU (brazilian Mobile Emergency Care Service) and sent to attendance at the Goiânia Emergency Hospital (HUGO), presented polytrauma that had affected the right upper limb at shoulder and humerus level, with open fracture and with severe lesions in the homolateral hemiface.

Upon entering the hospital environment, following the Advanced Trauma Life Support protocol (ATLS), it was found that the patient maintained spontaneous breathing, eupneic, hemodynamic stability, flushed, normotensive, with a heart rate of around 74 beats per minute and a temperature of 35 degrees Celsius, Glasgow 13, isochoric and photo reactants pupils, normal chest, flaccid abdomen without pain on palpation, diuresis present; no signs of cervical or spinal cord injuries were detected but with partial deficit in the affected upper limb.

When continuing the clinical evaluation in the head and neck region, there was a complete tearing of the skin and subcutaneous tissues in the right hemiface, with exposure of the mimicry muscles and also part of the mastication muscles with extension to the temporal region. Besides that, a complete avulsion of the ear was presented. Above the auricular pavilion insert, in a deeper plane, part of the parotid gland was not shown in its usual position. The insertion of the superficial portion of the temporal muscle and, more deeply, part of the coronoid process of the mandible were also altered (Figure 1).

Figure 1 - Moment of primary care, displacement of the pinna and anatomical replacement.



Source: Authors (2014).

The patient was referred for imaging exams, by means of which the possibilities of cranioencephalic injuries were excluded, as well as fractures of the facial bones. Thus, in the operating room, under general intravenous and inhalation anesthesia, trichotomy of part of the scalp was performed to the area involved in the trauma. In the vicinity of the upper and posterior margin of the wound, has been found the pavilion under the wicks, fully adhered to the set of stray tissues of the hemiface, with the appearance of good perfusion. The wound was cleaned using irrigation with isotonic saline solution (0,9%) and antisepsis with aqueous chlorhexidine solution. Preparation for reimplantation of the auricular pavilion and soft tissues has been carried out.

After the process of hemostasis and debridement was completed, the readaptation and repositioning maneuvers of the torn parts of the superficial portion of the temporal muscle began. The next step was the repositioning of the skin and subcutaneous tissue, with regularization of the lacerated parts and, finally, the rotation of a pedicle in the posterior inferior part, below the auricular pavilion, comprising the lateral trigon of the neck, in order to cover the part where there was a loss of substance (Figure 2).

Figure 2 – Intraoperative period and tissue repositioning



Source: Authors (2014).

During the transoperative period and immediate postoperative period, were instituted 1.0 g of Cefazolin intravenously and maintained for seven days, Tenoxican 20 mg intravenously every 12 hours for three days, and symptomatics if necessary. In addition, the tetanus vaccine and booster anti-tetanus was also made. The local dressing was done with the application of the ointment collagenase, being the first dressing remained for 48 hours due the patient's clinical condition. The subsequent bandages were changed at 24-hour intervals.

After the surgical reconstitution, the patient was referred to the intensive care unit, where she remained for a period of eight days, where a tracheostomy was made. Signs of good healing and formation of granulation tissue with some points suggesting superficial necrosis were observed. The wound was cleaned using copious irrigation with 0,9% isotonic and the ointment collagenase applied. On the eighth day, all sedative medications were removed and the patients returned to her normal status of consciousness, and the tracheostomy cannula was removed after the fourth day of extubation. Hemiface with signs of repair, good blood supply and granulation tissue layer was observed, also the absences of infection. As the upper limb was compromised, as recommended by the orthopedics team, the hospitalization period was extended for a further 15 days and, in the meantime isolation of the infirmary was recommended so that the face wound could be kept uncovered and the cleaning and dressing only with the ointment.

After hospital discharge, follow-up was performed every 15 days until 60 days after surgery (Figures 3, 4 and 5) And from then on, the patient was referred to a private dermatology and plastic surgery service for additional treatments, undergoing treatment with fractional CO2 laser in 12 sessions monthly and also 5 sessions after 6 months, together with filling in the eyebrow region and application of hyaluronic acid in order to prevent and reduce keloids.

Figure 3 – 7-day post-operative period.



Source: Authors (2014).

Figure 4 – 30-day post-operative period. A: front view. B: side view.



Source: Authors (2014).

Figure 5 – 60-day post-operative period. A: patient in 3/4 position. B: side view.



Source: Authors (2014).

The patient was followed up for 6 years and the result obtained corroborate with the literature. (Figures 5 and 6) In terms of initial treatment and complementary treatments that, in the case in question, were decisive for the final, aesthetic and functional results. The use of collagenase ointment will should be instituted in other cases to confirm the results obtained in the case reported here. In terms of initial treatment and complementary treatments that, in the case in question, were decisive for the final, aesthetic and functional results.

Figure 6 – 3-year control with mimic functions restored. A: patient with mouth at rest. B: patient smiling.



Source: Authors (2017).

4. Discussion

According to the literature, the facial trauma is more commonly related to falling from one's height, vehicular accidents, caused by sharp objects, animal bites, sports and interpersonal violence. Complex damage may be observed, both in soft and hard tissues, as abrasions, bruises, avulsions and fractures.(Archibald et al., 2025; Braun & Maricevich, 2017; Paasche et al., 2024) The wounds in critical scarring areas can be quickly stabilized, while those that affect more vascularized tissues such as scalp, should be closed as soon as possible, in order to promote effective hemostasis. Other structures, such as lacrimal canal, facial nerve, eyes and parotid duct need extra care. In cases of large avulsions, the possibilities of implantation and preparation of irrigation grafts must be considered.(Maia et al., 2018; Paasche et al., 2024)

Severe facial trauma when involving multiple anatomical units, can compromise facial aesthetics, so that different constituent subunits require different care in different aspects. Withal, although it requires a similar reconstruction to the scalp lesions, the frontal area is an aesthetic subunit and care must be taken in order to approach the tissues without tension lines on the hairline and eyebrows. Likewise, trauma involving the periorbita must be treated taking in account the damage to the eyeball and adjacent structures such as the conjunctiva, tarsus, also the medial and lateral parts of the eyebrow, corner of the eye. The repairs may require canthalplasty or the cantopexy. In the lips reconstitution, the anatomical realignment must be considered, as well as the muscular and sensory function, through primary closure, skin graft or flap rotation. At the same time, auricular pavilion injuries should be treated immediately, especially in cases where cartilage is exposed by means of sutures which cover the perichondrium or drainage of possible bruises. It is important to consider that more severe damages or even avulsions require graft or flaps repairs.(Archibald et al., 2025; Braun & Maricevich, 2017; Demke et al., 2024; Paasche et al., 2024)

Considerations of the subsequent scare must be done, which forms when the deep reticular layer of the skin is violated, forming new collagen fibers. In this process, four stages of healing are well distinguished, such as coagulation, hemostasis, inflammation and remodeling which, during the last two stages of proliferation, fibroblasts migrate into the wound, initiating the process to make new adhesion. From this moment onwards, type III collagen forms and is replaced by type I collagen over time. This change is an important factor in the firmness and appearance of the scar in recent wounds because, while type III fibers accommodate as well as vessels and viscera, type I collagen fibers gradually adjust and stretch and naturally become more rigid.(Braun & Maricevich, 2017)

Some factors are of extreme relevance for the treatment of facial soft tissues traumas. In addition to anatomical and initial aesthetics results, age, the medical condition and medications can predispose to the formation of scars. At the same time, diseases such as diabetes, collagen disorder, hypothyroidism, immunocompromised states and others may delay healing.(Welshhans & Hom, 2017) The nutritionist aspects, among them the deficiency of vitamin C, Vitamin K, Zinc and also in

irradiated areas above 50 Gy, type of injury and ethnicity can interfere in the repairs process. (Braun & Maricevich, 2017; Welshhans & Hom, 2017)

In this context, hyaluronic acid, an important component of the extracellular matrix, which firms the lining on the surface of cells, within which the cytokines and the growth factor β -1, are responsible for the collage production stimulus. Once increased, found in the keloids, is attributed to the increase in synthesis, not to the decreased in degradation mediated by the CD44 receptor. Thus, keloids are characterized by an excessive connective tissue matrix 6, caused by an accumulation of collagen types I and III (Hoffmann et al., 2012; Welshhans & Hom, 2017). Therefore, the transforming growth factor β -1 (TGF- β -1) is a stimulator in the production of collagen, and it is believed that hyaluronic acid could try to keep TGF- β -1 around the cellular micro involvement. (Alaish et al., 1995) If the proliferative process during healing is very marked, an excess of scar tissue can form, which result in the formation of high dermal scars. Keloids occur frequently in skin and dark populations, including Africans, Americans, Hispanics and Asians. (Hoffmann et al., 2012)

Some principles are already accepted to minimize scarring, among them, the debridement of necrotic tissues, to reduce the risk of infection; keep the edges of the incision fresh, ensuring stimulation of the epithelium; clean the wound by means of copious irrigation with isotonic saline solutions and antiseptics; perform hemostasis and local drainage to prevent the formation of hematoma and seroma; absorb excess exudate from the wound to prevent skin maceration; divert saliva drainage to avoid bacterial contamination; keep the place as moist as possible with the application of ointments or hydrogels to stimulate epithelization; protect the wound from further trauma; in the wound with potential for infection, institute the appropriate use of topical antibiotics. (Demke et al., 2024; Maia et al., 2018; Tagliaferri et al., 2024; Wenzel et al., 2024)

There is a consensus in the literature consulted that, in addition to the procedures for hemostasis, regularization of the edges of the wound, primary closure should performed, when possible, and sometimes, flap rotation, in addition to adjuvant treatments for the prevention of scarring and wound remodeling. (Kerwin et al., 2014; Singh et al., 2017; Archibald et al., 2025) Strategies for the treatment of scars have been framed in two large groups: prevention and remodeling. Prevention has been done through the topical application of medications (ointments with antibiotics), silicone gel, vitamin E, lasertherapy (low intensity laser and fractional CO₂ laser), massage therapy, dermabrasion contactubex gel (garlic extract, heparin and allantoin), calcipotriol, tretinoin, imiquimod, polyhexanide, octenidine, avotermin, botulinum toxin, surgical procedures and antimitotic groups (5-fluorouracil, bleomycin, mitomicyn) and dermal substitutes. (Braun & Maricevich, 2017; Kerwin et al., 2014; Tagliaferri et al., 2024; Welshhans & Hom, 2017; Wenzel et al., 2024)

In relation to keloids, intralesional injection of steroids (Kerwin et al., 2014) has shown regression mainly due to the decrease in collagen, although the mechanism is not yet clear, it is believed that they can inhibit plasma proteases, allowing collagen degradation by collagenase (Alaish et al., 1995; Kerwin et al., 2014; Welshhans & Hom, 2017), as well as intralesional applications of antineoplastic substances such as bleomycin and 5-propyl tiouracil. (Kerwin et al., 2014)

The addition of hyaluronic acid can assist in the repair of wounds, stimulating the signaling pathways, allowing tissue repair to occur more quickly, although more studies related to this mechanism should be performed (Sidgwick et al., 2013). Other studies have shown that hyaluronic acid has the ability to normalize some changes related to keloids such as hyper proliferation activity, growth factor production and cell matrix deposition, depending on the genotypic specificity of the keloid fibroblast lineage. (Hoffmann et al., 2012)

Laboratory studies (in rats) in comparison with other ointments, have shown that the daily application of collagenase in treatment started 24 hours after surgical treatment and extended for 9 days promoted the formation of crust in 10%, in the 3rd day; on the 5th day, 50% of the rats had scabs, and on last day, 20% of the rats. Granulations tissue appeared on the 3rd day in 80% of the animals; on the 5th day, 50% of the rats maintained the granulation tissue, and on the last day, it occurred in 10% of the

animals. The presence of overcoming was observed on the 3rd day in 30% of the animals and after this time, it was absent. Partial healing started on the 7th day in 10% of the rats and, on the last day, in 60% of them, while total healing was not observed in this time interval. (Alves et al., 1970)

Collagenase is an enzymatic proteolytic preparation obtained from bacterial fermentation process from *Clostridium histolyticum*, and is indicated to debridement of wounds, removing devitalized and necrotic tissue, consequently, facilitating the healing process. The complete cleaning of the lesion occurs in a variable time which ranges 2 to 24 days in general. (Patry & Blanchette, 2017) Another concern is that the literature reinforces the possibilities of involvement of blood vessels that incur blood losses from the smallest to the largest, and situations of hemorrhagic shock that need to be established. In this regard, hematological examinations ensured all hemodynamic stability and were done in this patient, with no requirement for any replacement. (Maia et al., 2018; Singh et al., 2017)

Proper assessment and treatment can prevent many complications from facial injuries, including the prevention of scarring and keloids. Immediate surgical treatment of wounds requires decontamination and antisepsis, debridement and removal of foreign bodies and abundant washing and irrigation with isotonic saline solutions and antiseptic solutions, as done in this case. Face dressings should preferably be moist, using ointment or mineral oils, preferably open, except in the first 24 hours. (Braun & Maricevich, 2017; Demke et al., 2024) The application of collagenase ointment, in the case reported here, demonstrated efficacy in all stages of the repair process, keeping the wound clean and free from secretions, proving the ability to debridement, formation of granulation tissue and stimulation of the healing process.

5. Conclusion

In conclusion, the formation of thin scars is inevitable, however the thicker and keloid scars can be minimized by well-planned surgical treatment combined with dressings. The early intralesional application of substances to avoid or minimize scars, implementation of hyaluronic acid, low intensity CO2 laser, pulsed laser, corticosteroid, among others related in this project are options, and deserve further studies.

Conflict of Interest

The authors declare no conflict of interest regarding this study.

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