

## Facial skin injuries caused by individual protectors in the combat to covid-19

### Lesões cutâneas faciais causadas por protetores individuais no combate à covid-19

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#### ABSTRACT

The single-stranded ribonucleic acid coronavirus is the seventh known member of the Coronaviridae family to infect humans. The droplets and aerosols that are suspended in the air with the virus can be transmitted by contact with the oral, nasal and eye mucosa, which can cause severe acute respiratory syndrome. Due to the outbreak of the new coronavirus disease, the constant use of personal protective equipment by health professionals has become necessary, as the virus has a rapid and widespread spread. But, unexpectedly, the coronavirus outbreak brought another concern, the emergence of facial injuries due to the continuous and inappropriate use of these individual protectors, harming the health of these professionals. An alternative to alleviate and prevent such injuries would be the use of prophylactic creams and dressings in places where there is pressure caused by these equipment, as well as relieving the loads generated by them, at intervals that do not exceed 4 hours. Therefore, this literature review aimed to report the potential for the emergence of facial injuries caused by the continuous and inappropriate use of PPE, highlighting the most affected areas, the risks to the health of the professional, prevention and treatment, through the electronic consultation based on of data, PUBMED, SCOPUS and Bireme/BVS.

**Indexing terms:** Coronavírus. Dentistry. Personal protective equipment. Skin.

#### RESUMO

*O Coronavírus possui ácido ribonucléico de fita simples, sendo o sétimo membro conhecido da família Coronaviridae que infectam humanos. As gotículas e aerossóis que ficam suspensas no ar com o vírus pode ser transmitido por contato com mucosas bucal, nasais e oculares, podendo causar a síndrome respiratória aguda grave. Devido ao surto da nova doença do coronavírus, tornou-se necessário*

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*a utilização constante dos equipamentos de proteção individual pelos profissionais de saúde, visto que o vírus possui disseminação rápida e generalizada. Mas, inesperadamente o surto do coronavírus trouxe outra preocupação, o surgimento de lesões faciais pelo uso contínuo e inadequado destes protetores individuais, prejudicando a saúde desses profissionais. Uma alternativa para amenizar e prevenir tais lesões seria a utilização de cremes e curativos profiláticos nos locais onde há pressão causada por estes equipamentos, assim como o alívio das cargas geradas pelos mesmos, em intervalos que não ultrapassem 4 horas. Diante disso, esta revisão de literatura objetivou relatar o potencial de surgimento de lesões faciais causado pelo uso contínuo e inadequado dos EPI's, evidenciando as áreas mais acometidas, os riscos à saúde do profissional, a prevenção e o tratamento, através da consulta eletrônica à base de dados, PUBMED, SCOPUS e Bireme/IBVS.*

**Termos de indexação:** *Coronavírus. Odontologia. Equipamentos de proteção individual. Pele.*

## **INTRODUCTION**

The outbreak of a new disease, which emerged in late 2019 in China, in the city of Wuhan, has become a global public health problem. A new coronavirus, the seventh known member of the Coronaviridae family to infect humans, is the cause of Severe Acute Respiratory Syndrome (SARS-CoV-2), which corresponds to a single-stranded ribonucleic acid (RNA) virus, which as the etiologic agent of coronavirus-2019 disease (COVID-19). Certainly, transmission occurs directly through coughing, sneezing and inhalation of droplets and transmission through contact with oral, nasal and ocular mucous membranes [1,2].

In view of the current situation, healthcare professionals around the world are in contact on the skin of the face, continuously, with individual protective equipment (IPE), working exhaustively for hours. In addition to the stress related to the daily fight to contain progress and care for patients, these same professionals are suffering from other types of stress that are caused by IPE's, as these devices are hermetically sealed causing sweating, in addition to limiting their functions by causing that the organism works under stress, increasing even more the moisture of the skin that becomes weakened and under mechanical pressure and friction the skin breaks, resulting in unexpected skin lesions [3,4].

Thus, health professionals must take precautions in relation to the spread of infectious respiratory diseases, by inoculation in the nasal, ocular and oral mucosa, the main transmission routes, due to the formation of aerosols during dental care. Many of the IPE's are already routinely used in dental practice, however, it becomes necessary to reinforce their use during care at this time of pandemic. Both dentists and other front-line professionals should wear a N95/PPF2 mask, cap, glasses, face shield, disposable waterproof apron, gloves, and other protective measures in dental offices and hospitals [5,6].

Droplet and aerosol particles from infected individuals in dental clinics and hospitals are small enough and may remain airborne for a long period before depositing on environmental surfaces or entering the respiratory tract [7].

Therefore, the pandemic has brought the effects of facial injuries into sharp focus, because, due to the considerable increase in the number of patients needing intensive care worldwide, the time and amount of IPE used by health professionals to contain the advance has increased virus and to maintain urgent and emergency care caused by this and other pathologies [8].

The skin has an integrity limit that can be broken by prolonged and inadequate use of protective equipment, as pressure, time and moisture weaken the skin, making it more prone to damage by mechanical action, resulting in pressure ulcers related to these devices. In addition to the inconvenience, the wound becomes a gateway, further increasing the probability of infection by the coronavirus and other pathogenic microorganisms [8,9].

Lesions are most reported in anatomical sites such as the nasal bridge, cheeks, ears and forehead.<sup>8</sup> In order to prevent and treat injuries, loads that put pressure on the tissues must be relieved after a few hours of work and the use of a preventive coverage in contact areas and especially pressure points [1,3].

Therefore, this literature review aimed to report the potential for the emergence of facial injuries caused by the continuous and inadequate use of IPE, highlighting the most affected areas, the risks to the health of the professional, prevention and treatment.

The methodology presented below, although under study, is of great interest to the dental field as well as to other areas of health and is related to a topic that, especially during the pandemic, became quite evident. The narrative review of the literature was carried out in July 2020, through the electronic consultation of the databases, PUBMED, SCOPUS and Bireme/BVS. A search strategy was carried out with free and monitored terms, divided into four components: The first brought together the participants, that is, professionals from Dentistry and other areas of health: (Dentist) OR (Dentistry); (Health professionals) OR (Emergency); (Health professionals) OR (Frontline); The second gathered terms related to the exposure, that is, the intervention to be reviewed: (Facial injury) OR (Individual protection equipment); (Facial injury) OR (Mask); (Pressure ulcer related to devices) OR (Face); (Skin lesion) OR (Facial injury); (Skin lesion) OR (Pressure); The third grouped the terms related to the treatment of injuries: (Prevention) OR (Skin lesion); (Treatment) OR (Skin lesion); The fourth, defining terms of the final resolution "COVID-19" (Supplementary Concept) OR (2019 novel coronavirus disease) OR (Covid-19) OR (Covid-19 pandemic) OR (Sars-Cov-2 infection) OR (Covid-19 virus disease) OR (2019 novel coronavirus infection) OR (2019-ncov infection) OR (Coronavirus disease 2019) OR (Coronavirus disease-19) OR (2019-ncov disease) OR (Covid-19 virus infection). The "OR" operator was used to retrieve any of the descriptors. Finally, the "AND" operator was used to combine the groups with each other.

Studies should: a) address facial injuries caused by individual protective equipment (IPE), Dentistry, COVID-19, injury prevention and treatment; b) be available in languages accessible to the authors (Portuguese, English or Spanish); and c) have been published from November 2019 to June 2020. The title and abstract of each identified publication was read, excluding works that did not meet the inclusion criteria.

## **Historical perspective of coronavirus (SARS-cov-2) and implications for the intermittent use of individual protective equipment**

In November 2019, an outbreak of respiratory disease, caused by the new coronavirus (SARS-CoV-2), was detected in the city of Wuhan, China. The infection spread rapidly, and on January 30, 2020, the World Health Organization (WHO) declared a public health emergency of international concern. On March 11, 2020, that organization declared a pandemic for the new coronavirus and suggested that only emergency and urgent procedures be performed during the outbreak. Since then, professionals around the world have been working tirelessly to contain and reduce the lethality of this new pathogen [2].

The number of illnesses related to the use of protective devices has become quite common among healthcare professionals worldwide. During practice, the teams reported that there was sweating after 30 minutes of using IPE's. This is due to the fact that the devices are very hermetic and the vapors and sweats do not volatilize, resulting in accumulated moisture in the skin, making the stratum corneum thinner and softer and, consequently, more susceptible to mechanical forces, which increases the risk for the appearance of injuries [6].

In order to prevent and alleviate pressure injuries, it is necessary to relieve mechanical loads every 4 hours, as well as use hydrocolloid and hydrogel dressings [3].

Certainly, a variety of protective clothing and the selection of the most suitable IPE are available on the market for different applications, being considered the ideal protector, the one that presents the best ergonomic characteristics and the best user tolerance [10].

These IPE's are manufactured in a standardized way, considering that the individuals have characteristics in common, however, each one has anatomical particularities, either in the shape or in the other parts of the face. Since there is no possibility of adjustments to these equipment, there may be exaggerated pressure, potentiating injuries and/or infections in some professionals. However, in the long term, bioengineers, regulators and industries must analyze and develop improvements in product technology and testing standards in relation to IPE's, improving the quality of protective devices, providing air filtration, good sealing, manufacturing in standard size, but be adjustable to each individual's facial contours, minimizing the risk of skin damage [8].

## **Skin and IPE's characteristics: Onset of lesions and the risk of infection by SARS-CoV-2**

In fact, the prolonged use without interruption and the inappropriate use of IPE's has caused injuries that cause pain, discomfort and put health professionals at risk, as they create yet another gateway for both the new coronavirus and other microorganisms [1,3].

The new coronavirus stands out for its speed of spread and pathogenic severity, requiring the health system to be highly prepared to meet the large demand of patients affected by the disease and the management of samples for diagnoses that require the use of various IPE's to be used with more rigor and for a longer period of time, by professionals exposed on the front line [8].

Because the aspect and specificity of the dental profession involves face-to-face communication with patients and being in direct contact with saliva, blood and other bodily fluids, professionals in this area invariably run a high risk of infection by the SARS-CoV-2 virus. In addition, aerosols and droplets contaminated by the virus are produced, which can remain in the air and on surfaces for a long time. Therefore, patients and dentists can be exposed to pathogens, including viruses and bacteria that infect the oral cavity and the respiratory tract, in dental clinics or hospitals, especially during the outbreak of this new coronavirus [7].

The skin is the first biological defense barrier against microorganisms present in the environment and is routinely exposed to chemical agents and subject to mechanical pressure and friction forces that alter its protective properties. Certainly, the disintegration of the first line of defense is due to the coefficient of friction, calculated when two surfaces come into contact with each other, such as skin and other materials. This break occurs due to the influence of the nature of textile materials, the contact pressure, the characteristics of the skin, the movement and the humidity of the environment and the skin itself [1,4,8].

Therefore, skin lesions are caused due to pressure, friction and excessive moisture over time of use, as IPE's weigh and make the environment hermetic, increasing perspiration, which stimulates the skin and causes itching and redness and, consequently, the weak acidity of the skin surface is destroyed, in addition to a reduction in evaporation, making the skin barrier weakened and more susceptible to the action of external forces. Furthermore, the pressure exerted also alters the local blood circulation causing ischemia and tissue hypoxia, resulting in tissue damage, which occurs mainly in regions with bony prominences with little adipose tissue [1,11].

In this way, continuous static (straps) and dynamic (sliding) friction forces on the skin tissue cause remarkable deformation, as rigid materials such as straps and flanges of masks and goggles mechanically induce direct damage to the scale cell of the skin of the face, including the natural movements of the face related to speech and facial expression move several facial skeletal muscles, changing the movement of the topography of the face, causing the IPE's strips and frames to tighten and slide causing friction in the regions of contact [8].

The breakdown of skin integrity manifests as a wound under the contours of protective equipment, being described as: Device-Related Pressure Ulcers (DRPU); Contact eczemas; Tears from the skin; Friction injury; Irritating contact dermatitis; and, Skin Damage Associated with Moisture (SDAM) [8].

Devices can be the main cause of injuries to various parts of the head and neck, due to continuous and inadequate use. The most compressed places are the nasal bridge, cheeks, forehead, ears, temples and the back of the head [3,12].

In addition to pain and discomfort, injuries, even on a microscopic scale, can trigger secondary inflammatory damage and tertiary ischemic damage, as the loss of skin integrity creates a portal of entry for other pathogens that can reach the bloodstream resulting in potential fatality [8].

## **Classification of pressure skin lesions**

Pressure injuries (PI's) are classified as localized damage to intact underlying skin and/or soft tissue or as an open ulcer, which is usually over a bony prominence or is caused by IPE's on the skin. They occur as a result of intense

and/or prolonged pressure in combination with shear, which are also affected by the microclimate, nutrition, perfusion, comorbidities and conditions of the skin tissue itself. Furthermore, injuries are a reason for concern in health institutions, as they generate negative impacts due to pain, discomfort, delayed functional recovery and increase the risk of infections [11].

They can be classified, by the development of severity, into four stages: Stage 1 - intact skin with non-whitening erythema; Stage 2 - partial thickness skin loss with exposure of the dermis; Stage 3 - full thickness skin loss; Stage 4 - full thickness skin loss and tissue loss; Furthermore, they can be classified as non-classifiable pressure injury and deep tissue pressure injury [12].

## Methods for the prevention and relief of facial injuries

Mechanical loads should ideally be relieved every 2 hours or less, but should be performed every 4 hours or less [1,3]. Furthermore, professionals with autoimmune and chronic inflammatory disorders should avoid injuries by relieving the loads for 2 hours or less [13].

In addition to the pressure on the skin from the prolonged use of IPE's, skin lesions can also be caused by their inappropriate use. Therefore, in addition to being selected according to the level of risk and care they will provide, skin care products should be used before and after garments, as they form a protective film. Prophylactic dressings should also be applied to regions where the devices put pressure on the skin. These products, such as barrier protectors and moisturizing creams, which, due to their greasy nature, help to reduce perspiration and, simultaneously, reduce the coefficient of friction, and must be applied 1-2 hours before using the IPE, so that the fat of the cream/protector does not interfere with the sealing. The dressings, on the other hand, must be cut to adapt the contact regions [1,3,4,8,9].

Prophylactic dressings can be made of polyurethane foam, which is the most used, followed by extra thin hydrocolloid, both being self-adhesive, thin, soft, resistant, and having a good decompression effect. Both prevent displacement while reducing pressure and local friction [3,4,8].

## Treatment of cutaneous trauma according to the injury stage

Most superficial injuries occur mainly in stages 1 and 2 in which treatment can be performed by local decompression to prevent injury and infections, promoting repairs and, where there is already injury, continuous compression should be avoided and only use IPE's after normalization of skin integrity [1,3].

For stage 1 injuries, before using protective equipment, hydrocolloid dressings or foam dressings should be used to protect the area under pressure. Under the premise of not affecting the protective effect, every 1 to 2 hours, the appropriate fine adjustment of the protective equipment can be used to change the pressure point in order to relieve the pressure.

As for stage 2 injuries, which may present small vesicles with low tension, where it is not recommended to perforate such vesicles to avoid infections caused by open wounds. In these places, a foam dressing can be used for local protection and wait for the vesicles to self-absorb. On the other hand, in vesicles with high tension, act with strictly aseptic operation, and must be perforated with a sterile needle and after completely releasing the liquid, the vesicle skin must be retained first and the foam dressing must be fixed locally.

For lesions that are in stage 3 and 4, potable water, distilled water, and saline solution should be used to remove fragments of necrotic tissue and dressing residues from pressure-damaged surfaces, and then evaluate the entire region of the face. If there is no infection at the site, dressings can be used to treat the wound according to the amount of exudate: Elevated exudate: it is recommended to select a hydrophilic fiber dressing or an alginate dressing; Medium exudate: foam dressing can be selected. But if the wound is accompanied by infection, a dressing containing silver ions should be used, and if there is a theft or sinus tract, the dressing of choice would be one suitable to fill or drain according to the depth of the theft and sinus tract and leakage and, if necessary, surgical treatment [3,6].

## IPE's dress regulation

Wash and dry the face, specifically in the places where you will apply the dressing; Cut and adjust the material to the application site; The use of a prophylactic dressing (whichever one is chosen) must be continuously evaluated, monitored and reviewed by users in order to find the solution that best suits each professional; Apply gently in the respective areas, stretched without too much tension, however, avoiding wrinkles or folds; After applying the IPE, confirm its correct application on the prophylactic dressing material, without increasing unnecessary pressure/tension in the contact areas; Check the sealing of the IPE, with the dressing and with the skin [3].

## DISCUSSION

Through the application of the proposed methodology, 239 articles were found (chart 1). After reading the abstract and title of this sample, 224 articles were excluded for not meeting the inclusion criteria. Thus, the 15 articles most relevant to the topic were read in full, of which 3 were excluded because they were preliminary research reports, that is, they were not certified by peers. To systematize the extraction of data from the 12 selected articles, that is, that fully met the inclusion criteria, a table was created in which the following were registered: author and year of publication, country where the study was carried out, language in which the work was published, analyzed outcome, evaluation of results and type of studies (chart 2).

**Chart 1** – Search results in electronic databases.

Database	Search results	Selected articles
PUBMED	234	13
SCOPUS	0	0
BVS	5	2

**Chart 2** – Presentation of the results of selected studies.

Author / Year	Country where the study was carried out	Kind of study	Article language	Benefits	Limitations
Lo Giudice [2]	Italy	Editorial	English	Its purpose is to discuss the most adequate procedures and personal protective equipment to prevent infection during a pandemic.	-
Zhou et al. [3]	China	Editorial	Chinese / English	Useful for treating and preventing skin damage caused by protective devices.	-
Franco et al. [5]	São Paulo	Editorial	Portuguese	It emphasizes dental care during the pandemic.	-
Jiang et al. [6]	China	Cohort study	English	It allows to show in practice that the medical team suffered skin damage caused by inadequate and prolonged use of protective devices.	-
Peng et al. [7]	China	Editorial	English	Alerts transmission routes, noting that the use of IPE's is of great importance.	-
Gefen & Ousey [8]	Italy	Cohort study	English	Allows you to guide professionals in the front line strategy on care for the prevention of damage to the skin.	-
Li et al. [9]	China	Cohort study	Chinese / English	It shows that the prolonged use of personal protective equipment associated with sweat and friction causes skin lesions.	-

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**Chart 2** – Presentation of the results of selected studies.

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Author / Year	Country where the study was carried out	Kind of study	Article language	Benefits	Limitations
Loiber et al. [10]	USA	Cohort study	English	Useful as it analyzes the impact of IPE on the health professional's performance and comfort during the pandemic.	-
Jiang et al. [12]	China	Cohort study	English	It allows to demonstrate the prevalence of skin lesions in medical teams caused by IPE's in combating COVID-19.	-
Darlenski & Tsankov [13]	Bulgaria	Editorial	English	Precaution as a measure to prevent skin complications during a pandemic.	-
Hu et al. [14]	China	Quantitative descriptive study	English	Allows you to analyze the long-term incidences of the use of IPE's	-
Smart et al. [15]	Bahrain	Cohort study	English	It analyzes whether a dressing on the skin reduces the damage caused by masks and damages the seal.	-

Unexpectedly, in addition to the pandemic causing damage characteristic of the virus, it also brought physical and physiological damage to health professionals due to the use of IPE's. Thus, a study by Jiang et al. [6] in hospitals in Wuhan and other cities in China, showed that due to the severity and high contagion of the new coronavirus, it became essential that front-line professionals use IPE's with reinforcement and for long periods. Such prevention and protection measure, unexpectedly, led professionals to skin lesions due to use for long periods and the lack of information regarding measures to prevent such damage. The Chinese government in order to solve and protect health professionals issued an emergency warning on February 19, 2020, calling for the strengthening of health and safety protection of medical professionals during the prevention and control of the epidemic, as the outbreak of COVID-19 has caused many problems worthy of global attention, including, unusually, skin lesions caused by the use of the devices by healthcare professionals.

Jiang et al. [6] in another study carried out at the hospital in Wuhan, found that medical teams in the fight against COVID-19 worked daily for 8 to 12 hours using IPE's, and pressure and sweating would be factors in breaking the integrity of the skin appearing lesions that harm health and increase the risk of infection by microorganisms, including by coronavirus. One of the ways to prevent the appearance of lesions would be to relieve loads on the skin every 4 hours and use dressings and prophylactic lotions.

According to Hu et al. [14], in Hubei province, the use of IPE's caused adverse reactions in the team of doctors and nurses, the damage to the skin included itching, dry skin and scarring. Darlenski & Tsankov [13] also reported that the use of IPE's caused pressure injury, contact dermatitis, pressure urticaria and exacerbation of preexisting skin conditions, including seborrheic dermatitis and acne, in addition to other clinical manifestations such as burning sensation. and itching.

Already, Gefen & Ousey [4] carried out studies with the purpose of providing an easy and simple strategy to prevent the risks of personal damage to the skin during the pandemic, through measures that help to reduce the damage caused by the pressure of the skin. protective devices, such as load relief every 2 hours and use of prophylactic creams and curatives before using the protective devices.

In Bahrain, at King Hamad University Hospital, a study by Smart et al. [15], in search of prevention for health professionals. It was observed that the skin protection performed through silicone edge dressings, when well adjusted, do not compromise the sealing effectiveness of the N95 mask, and that load relief every 4 hours reduces discomfort and the incidence of injury. After performing this test with the medical team, they reported greater comfort and less friction.

Lo Giudice [2] in Italy and Peng et al. [7], in China, carried out studies in which they discussed the most appropriate dental procedures and IPE's to prevent infection during a pandemic. Also, Franco et al. [20] reported the importance of biosafety and the modification of care to avoid contamination by COVID-19. However, Zho et al. [3], in China, reinforced

that, in addition to the IPE's of the Nursing team, it is necessary that professionals use ointments and prophylactic dressings in order to prevent and alleviate the pressure that the devices exert on the skin. It also describes the steps for placing and removing the skin protection and IPE's and the stages of the lesion.

Li et al. [9], in China, studied the methods of treatment and prevention measures for skin problems for medical staff, as masks, glasses, protective screens and protective clothing for a long period of work caused damage to the skin, such as allergic reactions, pressure or microorganism infections. It also included common medications for the treatment of injuries. Furthermore, Loiber et al. [10], in the United States, analyzed the temperature of participants performing activities over a period of time, to assess the health professional's performance and comfort, and both the increase in body temperature and fluid loss were perceived by professionals as moderate to high.

## FINAL CONSIDERATIONS

During the current COVID-19 pandemic, due to the continuous and inadequate IPE's use, facial injuries related to these devices were reported, putting the health of professionals at risk during their professional practice.

Due to the fact that Dentistry is a profession that produces a lot of aerosols, it was necessary to take measures to increase protection, making use of various IPE's such as N95/PFF2 mask, cap, goggles, face shield and disposable waterproof apron.

However, IPE's can cause injuries if there is no respect for the rules established to prevent this type of damage, such as relief during a time of use and application of products before and after clothing.

Therefore, several ways to prevent facial lesions caused by IPE's have been proposed, through the use of moisturizing creams and prophylactic dressings, as well as a control over their use time, which should be removed every 4 hours at most.

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