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Corticosteroids in Dentistry;Clinical Review

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ABSTRACT: *Corticosteroids are one of the extensively used drugs in dentistry. It is regarded as a double- edged sword. On one side it is extensively used because of its excellent anti- inflammatory and immunosuppressive properties whereas on the other side it has certain contraindications.* ***The current review gives an insight view of its diverse usages, side-effects, and contraindications in the certain dental procedures.***

KEYWORDS: Anti-inflammatory, corticosteroids, dentistry, immunosuppressive.

INTRODUCTION:

Corticosteroids are hormones produced in the cortex of the adrenal gland. They are glucocorticoids, mineralocorticoids and a small amount of androgens. Cortisol is the major glucocorticoid while aldosterone is the major mineralocorticoid. The secretions of the adrenal cortex are under the control of ACTH secreted by the anterior pituitary and this is in turn regulated by CRF and plasma corticosterone levels. This is termed hypothalamic-pituitary-adrenal axis.[1]
The corticosteroids have a cyclopentanoperhydrophenanthrene (steroid) ring. They are synthesized in the adrenal cortex from cholesterol under the influence of ACTH. Everyday about 10-20 mg of hydrocortisone (maximum in the early morning) and 0.125 mg of aldosterone are secreted. They are also released in response to stress.[1,2] Glucocorticoids promote gluconeogenesis and glycogen deposition in the liver and inhibit peripheral utilization of glucose resulting in hyperglycemia.[1]Glucocorticoids are catabolic hormones, because they enhance protein breakdown and nitrogen is excreted leading to negative nitrogen balance.[2] Glucocorticoids promote lipolysis and redistribution of fat takes place–fat is mobilized from extremities and deposited over the face, neck and shoulder and this fat deposition in excess glucocorticoid activity is described as 'moon face', 'fish mouth' and 'buffalo hump.[1.2]

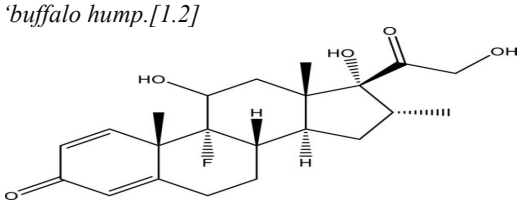

Figure 1. Structure of 9α-fluoro-16α-methylprednisolone (dexamethasone*The molecular mechanism of corticosteroids is known as that corticosteroids enter the cells by simple diffusion, bind to specific receptors in the cytoplasm and activate them. The drug- receptor complex is then transported into the nucleus where it binds to specific sites on DNA and induce the synthesis of specific mRNA. By this they regulate the synthesis of new proteins mainly lipocortin-1, which inhibits the activity of phospholipase A2 thereby decreasing the production of prostaglandins and leukotrienes, and hence suppressing the development of inflammatory response to all types of stimuli, that bring about anti-inflammatory and immunosuppressive effects .[1,3]* **Figure 1.**
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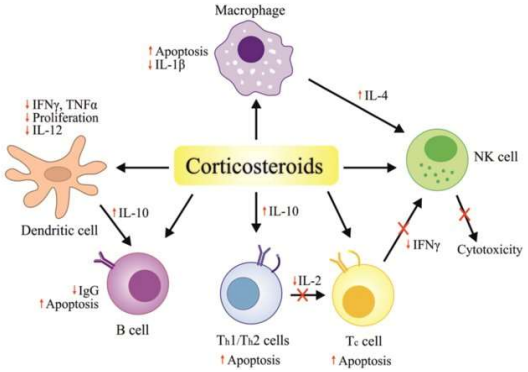

Fig.2 Mechanism of action of corticosteroids. Corticosteroids diffuse across the cell membrane and bind to intracellular receptors that translocate into the nucleus. This complex interacts with DNA, resulting in altered transcription of various corticosteroid-responsive genes. Corticosteroids have diverse physiological effects and directly or indirectly regulate several different immune cell as shown here. These actions are primarily accomplished by modulating inflammatory cytokines as well as through induction of apoptosis.

Glucocorticoids inhibit both early and late manifestations of inflammation. Inhibition of late response like capillary proliferation, collagen deposition, fibroblastic activity and scar formation may delay wound healing. They inhibit migration and depress the function of the leucocytes and macrophages and inhibit the release of chemical mediators. The ability of these cells to respond to antigens is decreased. Glucocorticoids - even a single dose bring about a decrease in the number of WBCs lymphocytes, monocytes, eosinophils and basophils decline. Glucocorticoids thus suppress cell-mediated immunity, prevent manifestations of allergy and prevent homograft rejection. Large doses also inhibit antibody production.[4]
Glucocorticoids reduce capillary permeability, thereby reducing fluid exudation and maintain the tone of arterioles. They have a positive inotropic effect on the heart. Prolonged use can cause hypertension.[2]
They are required for normal functioning of the central nervous system. Deficiency results in apathy and depression, while large doses result in restlessness, anxiety and sometimes psychosis. They are essential for normal muscular activity.[5]
Glucocorticoids inhibit absorption and enhance the renal excretion of calcium–they antagonize the effect of vitamin D on calcium absorption, which is associated with bone resorption. [1]
Glucocorticoids also have a weak mineralocorticoid action– cause some salt and water retention and potassium excretion. Some synthetic glucocorticoids are devoid of this activity.[5]

PHARMACOKINETICS;
Most glucocorticoids are well-absorbed orally. Hydrocortisone undergoes high first pass metabolism. It is 95% bound to plasma proteins–corticosteroid binding globulin (CBG) or transcortin. Glucocorticoids are metabolized in the liver by oxidation and reduction followed by conjugation. Metabolites are excreted by the kidneys. The Preparations Glucocorticoids are given by many routes - orally, parenterally, topically, by inhalation and nasal spray. They may also be injected intra-articularly. The synthetic analogs are more potent than hydrocortisone and have less or no mineralocorticoid activity. [6] **Figure 2**
Hydrocortisone, the chief natural glucocorticoid is used orally and parenterally; in emergencies it is used intravenously.
Prednisolone has potent glucocorticoid with mild mineralocorticoid activity. It is the most commonly used glucocorticoid.
Prednisone is a prodrug converted to prednisolone in the liver.
Methylprednisolone is similar to prednisolone and is used as retention enema and for high dose pulse therapy.
Triamcinolone, dexamethasone, betamethasone have no mineralocorticoid activity and have selective, potent glucocorticoid effects.
Several glucocorticoids like hydrocortisone, dexamethasone and betamethasone are available for topical use as creams, ointments, nasal and eye drop.[1,4,6]
The current review gives an insight view of its diverse usages, side-effects, and contraindications in the certain dental procedures.

USES OF CORTICOSTEROIDS THERAPEUTIC ;
Corticosteroids are primarily used in two ways. First is replacement therapy. The adrenal cortex, anterior pituitary, or hypothalamus may have congenital or acquired defects, which can lead to an insufficient production of corticosteroids. Insufficiency can be classified as acute or chronic. Acute insufficiency can be defined as

adrenal crisis, which can be an emergency. It leads to extreme weakness, gastrointestinal symptoms, dehydration, and hypotension. It is likely to occur after long-term high dose therapy cessation. Drug induced suppression of the adrenal-pituitary axis is a serious complication[1,4] It may require up to 2 years for a full recovery. Chronic adrenal insufficiency is called Addison's disease. It has the same features of acute adrenal insufficiency but milder symptoms. The treatment of adrenal insufficiency is typically replacement with corticosteroids. Recovery from drug induced adrenal suppression is slow.[2,4] Patients who have previously taken corticosteroid for prolonged periods will require consultation with their physician before extensive dental treatment like removal of impacted teeth and quadrant periodontal surgery .[4,5] The second therapeutic usage is related to the suppression of inflammation and the immune response.[1,3] They are primarily involved not to act on the disease process but for relief of the signs and symptoms. It should be considered palliative treatment. Long-term usage of corticosteroids cannot be recommended to treat inflammatory conditions due to the significant side effects.[1,4,6] Other drugs such as NSAIDs, heat, and physical therapy are recommended for long-term treatment. Corticosteroids should be used for the shortest time and as adjuncts to other measures like NSAIDS and local measures. Corticosteroid can be given for typically a 1-week duration without significant suppression of the adrenal-pituitary function.[7] Postoperative sequelae can often be managed with other manners like proper surgical technique and usage of NSAIDs. In addition, dexamethasone has been used routinely in various surgeries requiring anesthesia for its ability to reduce postoperative nausea and vomiting.[6,8]

Corticosteroids usage in dentistry can also be applied to other clinical scenarios. Oral ulcerations from various diseases processes can be managed with corticosteroid medication. These oral ulcerations can be due to aphthous stomatitis, erosive lichen planus, angular cheilitis, geographic tongue, pemphigus vulgaris, and benign mucous membrane pemphigoid .[2,5]It important to emphasize that glucocorticoids do not manage the underlying disease process. [1,2]Topical corticosteroids are preferred to avoid systemic involvement for the treatment of oral ulcers. Acute pain related to Temporomandibular Joint Disorders (TMD) can be managed with corticosteroid medication.[1,8] However, it is preferred to manage these patients with non-drug alternatives such as rest, physical therapy, bite appliances, and heat treatment. The immunosuppressant and anti-inflammatory properties of corticosteroids are preferred in anaphylactic and allergic reactions. [2,3]They should be used in only severe cases, as H1 antihistamines are the drugs of choice in mild reactions. Epinephrine is the drug of choice for anaphylactic reactions but corticosteroids can be used in addition due to their long duration of action.[1,3,7,9]

Figure 3.

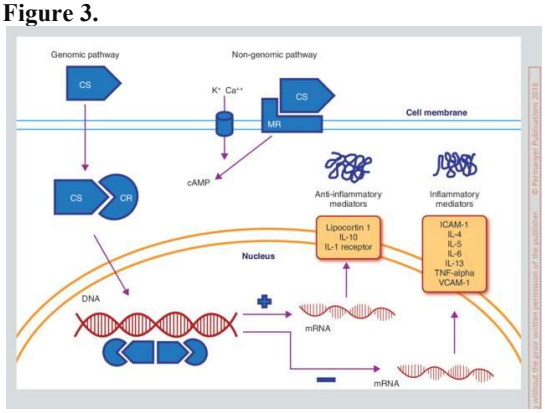

Figure 3' Cellular mechanism of action of corticosteroids in the inhibition of inflammation. Three anti-inflammatory mechanisms are originated by corticosteroids: (i) transactivation: increasing anti-inflammatory mediators, (ii) transrepression: decreasing inflammatory mediators, and (iii) increasing anti-inflammatory messengers through membrane-associated receptors. CR: corticosteroid receptor; CS: corticosteroids; ICAM: intercellular adhesion molecule; IL: interleukin; MR: membrane receptor; TNF: tumour necrosis factor; VCAM: vascular cell adhesion molecule.

The majority of corticosteroid treatment in dentistry has revolved around the reduction of inflammation and post-surgical symptoms like trismus, pain, and edema after removal of impacted mandibular third molars.[9] Surgical trauma as a result of tissue injury results in pain, edema, erythema, and loss of function like trismus. [2,4,8]Postoperative management typically involves a short intensive course of corticosteroids for the reduction of these symptoms. [7]Acute edema is related to excess fluid trapped in the surgical site. Initially after tissue injury high capillary permeability or capillary rupture may lead to overload of the lymphatic system due to leakage of fluid and protein into the tissue spaces . This results in swelling.[1,2] Edema is necessary for healing to occur however adverse events related to prolonged edema can compromise treatment results and create an environment ideal for starting of an infection. This can result in unwanted scar adhesions that occur by triggering the ongoing presence of fibrin around the site of injury. [3,5,7]Through suppressing the production of vasoactive substances like prostaglandins and leukotrienes, corticosteroids reduce fluid transudation and therefore edema related to surgical tissue injury. The peak of edema occurs typically at 48 hours post surgically but can increase

up until the third day .[9] Trismus is defined as reduced opening of the jaws that can interfere with daily activities like eating, speech, facial expressions, and oral hygiene.[1,5,9] Trismus post surgically is related to a buildup of fluid within the muscle of mastication or the temporomandibular joint. The usage of corticosteroids to manage postoperative pain is controversial. Although corticosteroids have potentially dangerous adverse effects as discussed previously, their incidence is typically related to long-term usage. Corticosteroids can be used prophylactically to manage postoperative symptoms and by reduction of inflammation. Corticosteroids can potentially reduce early wound healing complications in patients undergoing dental alveolar surgeries.[4,9,10]
Contraindications of corticosteroids are said to be absolutely contraindicated for use in patients with active or incompletely treated tuberculosis, active viral or fungal infections (especially ocular herpes), active acne vulgaris, primary glaucoma, or patients with a history of acute psychoses or psychotic tendencies.[1,4,11] Preoperative medical consultation might be prudent for patients with diverticulitis, peptic ulcers, Cushing's syndrome, renal insufficiency, uncontrolled hypertension, uncontrolled diabetes mellitus, pregnancy, lactation, acute or chronic infections, or myasthenia gravis.[12,13] The adverse effects on hypertension and glaucoma are related to mineralocorticoid activity and are not a problem with the newer derivatives, such as methylprednisolone and dexamethasone.[14]
The aim of this review is to analyze the previous usage of corticosteroids for dental alveolar surgeries and their treatment outcomes. The review should provide dental professionals further education about the pathophysiology involved with corticosteroids medications, guidelines for optimal usage, benefits, and risks of the usage of corticosteroids in various dentoalveolar surgeries.

Steroids in endodontics:

Figure 4; *Ledermix*

Steroid administration influences the occurrence of root resorption. The percentage of root resorption has been found to be more on treatment with corticosteroids. However steroid-antibiotic combinations like Ledermix have also been used as intracanal medicaments for management of root resorption with reasonable success.[15] Steroids like hydrocortisone are also mixed with zinc oxide eugenol to be used as root canal sealers. It appears that the action of steroids on root resorption is chemistry dependent.[15]

The incidence of inter appointment pain during endodontic treatment is of main concern to both the patient and the dentist. Many of them associate endodontic treatment with pain. Therefore, effective methods of anesthesia and analgesia are being commonly practiced to make endodontic treatment pain free.[16] **Figure 4**

Endodontic pain can occur prior, during or after the treatment. Post endodontic pain comprises of inter appointment pain and post obturation pain and is reported to occur in 25% - 40% of the patients undergoing endodontic treatment [1–4,15]. Endodontic pain is due to acute inflammatory reaction of the apical periodontal ligament which could be due to injury to vital nerve or pulp tissue, over instrumentation, forcing of debris or medicament beyond the apex or due to occlusal trauma [5–8]. Several drugs have been used to control this pain by interfering with the periapical inflammation. The commonly used drugs are non-steroidal anti-inflammatory drugs and steroids [9,17].
Use of corticosteroids topically for control of inflammation in a wide range of cases from pulp hyperemia to partial suppurative pulpitis was proposed by Schroeder in 1965 [18]. Mosteller in 1962 conducted a study where prednisolone was compared with control over 726 teeth undergoing operative procedure and found that the study group treated with prednisolone showed decrease in thermal sensitivity [19]. Corticosteroids have been in use as pulp capping agents and have also been suggested for control of pain in endodontics [12,14–16]. Corticosteroids are believed to stabilize cell membrane thereby blocking nerve impulse transmission [17].

Smith in 1976 has proved the topical application of steroid preparation to pulp or periapical tissues to symptomatically relieve endodontic pain [20]. A study conducted by Wolfson in 1954 proved the use of hydrocortisone in acute serous and suppurative pulpitis to reduce inflammation [21]. Gurney in 1974 was the first one to suggest that corticosteroids be gently forced into the periapical area for pain relief [22].

When corticosteroids are delivered locally, the dosage required would be much less that the oral formulation that is conventionally used as the local delivery would surpass first pass metabolism thereby reducing the magnitude of adverse effects as well as achieve target-oriented drug delivery and effective pain control [19,20].

Chance et al in 1987 conducted a clinical trial of intracanal corticosteroid in root canal therapy. Three hundred patients with both vital and non-vital pulp were included in this study. The subjects were randomly allocated in two groups. The experimental group received a solution of prednisolone acetate (2.5%) and the control group received saline. These solutions were delivered into the root canal after cleaning and shaping. Eleven experimental and nine control patients dropped out. Therefore 280 patients were evaluated with 133 in the control group and 147 in the experimental group. The pain was recorded at the end of 24 hours into four categories: no pain, slight pain but no medication required, moderate pain that requires mild analgesia and severe pain that requires a narcotic. It was seen that pain occurred more frequently in the control group than in the experimental group in cases of vital pulps whereas there was no significant difference in pain reduction among the groups in case of non-vital pulps. The analgesic effect of corticosteroid was explained to be due to its prostaglandin inhibition activity. This study proved the ineffectiveness of use of corticosteroid in case of necrotic pulps [23].

Rogers et al in 1999 compared the effectiveness of intracanal ketorolac, intracanal dexamethasone and oral ibuprofen in controlling inter appointment pain during endodontic treatment. For this study, 48 patients with vital pulps were taken and allotted into 4 groups of 12 each. Group 1 received oral ibuprofen, Group 2 received oral placebo, Group 3 received intracanal dexamethasone solution and Group 4 received intracanal ketorolac solution. Pain evaluation was done at 6, 12, 24 and 48 hours with VAS 0-100 scale. It was seen that intracanal ketorolac showed significant reduction in pain followed by intracanal dexamethasone and oral ibuprofen. The effectiveness of ketorolac is believed to be due to its strong inhibitory activity on the cyclooxygenase pathway which inhibits prostaglandin release. Moreover the delivery of this agent locally at the site of action would bypass the first pass metabolism and give effective pain relief [24].

Studies that used the intracanal route of administration of corticosteroid solutions for analgesia were not standardized and had low quality of evidence. All the studies used commercial preparation of corticosteroids that were available for oral or intravenous use. Evaluation of the cytotoxicity of the drug at the site of action has to be evaluated and the dosages should be standardized for intracanal delivery. In teeth undergoing endodontic treatment, the pain site is very specific and the surface area is small which makes it possible for target-oriented drug delivery so the dosage of drug required for intracanal administration would be much less than the oral dose. Therefore, further studies have to be carried out to standardize the safe and effective concentration of corticosteroids for intracanal use.[25,26,27]

Periodontal and implants;

Figure 5: Injection of hyaluronic acid into the alveolar socket before implantation on the experimental side

Periodontal and implant related procedures have evolved extensively with the evolution of different biologic materials. The ability to regenerate lost oral tissues has changed the surgical skills necessary related to these procedures. Procedures like mucogingival surgeries and guided bone regeneration require fine surgical technique but often involve extensive tissue trauma and a considerable postoperative inflammatory response.[28] The successes of these surgeries are often intertwined to the postoperative course of the patient. Avoiding postoperative flap dehiscence by reducing postoperative swelling can help achieve and maintain primary closure. Early wound complications are usually associated with little to no tissue gain .[29,30] Dependent on the extent of the procedure, ranges of wound complications vary. Following vertical guided bone regeneration, the incidence of wound complications ranges from 0% to 45% compared to the of autogenous bone blocks having a reported range of 0% to 4% .[31]It is pertinent to the dental professional to avoid early wound complications during regenerative procedures. **Figure5**

In a review of literature about long term administration of glucocorticoid and implant osseointegration by Fu et al. [32] provided conflicting results. Corticosteroids were shown to negatively affect bone healing due to a reduction in bone turnover and bone to implant contact. The review recommends a longer healing period before implant loading for patients taking glucocorticoid. The review only analyzed 4 animal model studies and 1 case report with only one patient. Various dosing regimens were also used and all were long-term administration of glucocorticoid. The results of this review should not be applied to pre- operative dosing concerns.[32]

Rotenberg et al. (2014) analyzed post-surgical edema related to mucogingival surgeries. Previously no study has analyzed early changes in gingival dimensions after sub- epithelial connective tissue grafting. Rotenberg was able to use standardized intraoral stents to directly measure intraoral changes in gingival thickness post surgically. It must be mentioned that previous studies discussed relied on extraoral facial changes to measure edema. Early changes in gingival dimensions are due to postoperative edema of graft and the overlying flap. Postoperative healing of connective tissue graft used for root coverage exhibits a transient increase in the bucco-lingual tissue dimension due to the edema. The study concluded that gingival thickness on average increased 96%, 47%, and 2% compared to baseline at days 3, 7, and 14. Edema could create more flap tension[33]. Burkhardt and Lang et al. (2010) showed that when flap tension was 5 grams or higher, a minimal risk of wound dehiscence was present, and forces greater than 25 grams carried a very high risk of wound complications.[34]

The usage of corticosteroids for periodontal and implant related procedures has not been investigated. Further research is necessary to confirm if the reduction of edema is an important benefit in periodontal and implant related procedures with the usage of corticosteroids.[35]

Orthodontic Tooth Movement;

The biology of orthodontic tooth movement comprises the study of cellular, biochemical and molecular phenomena occurring in the periodontal ligament and alveolar bone. The bone remodeling that occurs in the orthodontic movement is a dynamic process requiring coordinated cellular activities between osteoblasts, osteocytes and osteoclasts, in order to maintain the mineral tissue homeostasis. All these activities are regulated by chemical mediators, of cellular and plasmatic origin.[36]

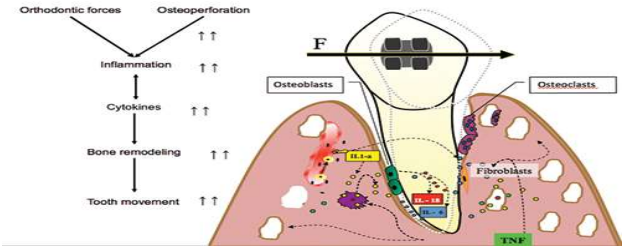

Figure 6. Cytokine cascade.

Several theories about orthodontic tooth movement have been proposed, and all of them present the bone resorption as one of the biological effects. In the first half of the twentieth century there was already concern about the action mechanism and the events triggered by the applied force on the dental crown. The pressure-tension theory was based on the vitality of the periodontal ligament, i.e., the stimulation applied to the ligament did not involve or require stimulation coming from other structures such as the alveolar bone, for instance. The collagen fibers and the vascular system were essential for the development of this phenomenon.[37] **Figure 6.**

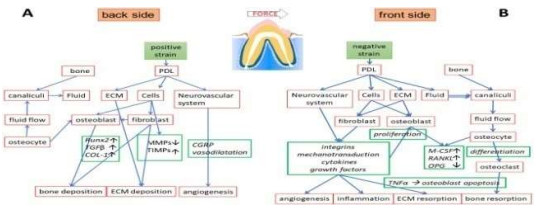

Fig. 7. Schematic representation of the most important structures and phenomena involved in orthodontic tooth movement. The tooth is moving to the right. (A) Back side of the tooth; (B) front side of the tooth

The effect of corticosteroids cannot be attributed to a single factor. It is mentioned the reduction in the activity of neutrophils, macrophages, fibroblasts and osteoblasts; reduction in cell migration to the inflammatory site and alterations in growth factors activity such as TGF-β1. In addition to increased synthesis of lipocortin 1 and blocking of phospholipase A2, inhibition of gene transcription of cyclooxygenase-2 (COX-2), therefore a reduced release of prostaglandins and leucotrienos.10 Hubner et al5 demonstrated that dexamethasone inhibits the expression of proinflammatory cytokines IL-1α, IL-1β and TNF-α, on induced skin wounds in rats.[38] **Figure 7.**

Regarding the bone tissue, corticosteroids have several effects. For Pharoah and Heersche[39] the drug reduces in a dose-dependent way the number of multinucleate osteoclast-like cells in culture of bone marrow cells from cats, while other authors claim that corticosteroids stimulate in vitro4,20 bone resorption in time and concentration dependent way, via increased activity and/or formation of osteoclasts.20 Osteoporosis and bone resorption have been associated with secondary hyperparathyroidism induced by corticosteroids.7 Ong et al[40] reported that the action of this drug may impair the formation of osteoblasts from osteoprogenitor cells and reduce collagen synthesis by mature osteoblasts.

Few studies have been conducted aiming to demonstrate possible action of corticosteroids on orthodontic tooth movement.

Ohkawa [41]administered hydrocortisone at a dose of 10 mg/kg in rats, induced tooth movement by means of an elastic band and evaluated the amount of mechanical stress required to extract the inferior first molars. According to the author, the load required to extract the tooth is inversely proportional to the strength of the periodontium and the remodeling of collagen fibers present in the periodontal ligament. It was observed that the mechanical stress is higher in the group that was given to hydrocortisone, and therefore the drug is able to slow down the remodeling of the collagen fibers periodontal after force application.

Yamane et al[42] evaluated in vitro the tooth movement after hydrocortisone administered at a dose of 10 mg/kg/day for 7 days on rats and observed for 20 hours the amount of movement of the first and second molars using a video recorder. It was found that the group treated with corticosteroid had a lower amount of tooth movement.

Ong et al[40] administered 1 mg/kg/day of prednisolone for 12 days before the induction of tooth movement in rats. There was lower number of TRAP-positive cells on the compression side, which indicates a suppressive action of this drug on the clastic activity.

According to Ramos et al[43] corticosteroids, when experimentally used, can modify the speed of induced tooth movement, but clinically, these changes do not reflect structural changes on the trabecular bone of the jaws since the jaw bones turnover is slower than the other bones. Furthermore, to detect the effects of these drugs on the tissues, the doses used in the studies are high and the for long periods, considering the animal's lifetime.

New studies should elucidate which molecular mechanisms are affected by the administration of corticosteroids simultaneously to application of orthodontic forces, including human studies, since animal studies have certain limitations.[44]

In 2009, a study was conducted to study the effects of steroidal and non-steroidal drugs on tooth movement and root resorption in the rat molar. The authors concluded that only prednisolone- and high-dose celecoxib-treated groups showed significantly less root resorption and less tooth movement. Administration of prednisolone and high-dose celecoxib reduced root resorption and interfered with tooth movement in rats. [45]

A study in 2012 tried to investigate the effect of different courses of glucocorticosteroid treatment on orthodontic tooth movement (OTM). The researcher found higher rate of OTM in steroid treated groups than control group. Among steroid treated groups short-course group showed higher rate of OTM compared to long course group. The study recommended postponing, wherever possible, orthodontic treatment till the acute phase of treatment with corticosteroid is over.[46]

In 2014 a study was carried out to evaluate the effects of triamcinolone acetonide injection on orthodontic tooth

movement in a rabbit model. It was found that treatment with triamcinolone acetonide was associated with increased tooth movement in rabbits via increased resorptive activity in the alveolar bone.[47]
After reviewing the existing literature on effects of corticosteroid on orthodontic tooth movement, it would not be wrong to conclude that, the results obtained so far are inconsistent and at times contradictory. It is also important to acknowledge the lack of any standardized protocol for research on the topic. This may have had an important bearing on the results obtained so far. Perusing the methodology of the above studies on can clearly observe that there are too many variables at play. The dosage, duration and rout of drug administration, magnitude of force applied to bring about tooth movement etc. Therefore, there is a pressing need for further studies (preferably human studies) on the topic.[46-50]

Temporomandibular Joint ;

The condyle/articular disc complex incoordination is among the temporomandibular joint disorders. It results from the collapse regarding the normal function of the disc on the condyle and it is due to disc collateral ligaments incompetence and lower retrodiscal plate. Examples of this case are disc displacements with and without reduction which may be associated with inflammatory changes such as capsulitis, synovitis and retrodiscitis or with degenerative changes such as osteoarthritis and osteoarthrosis of the Temporomandibular Joint (TMJ).[3,4,7,51,52] **Figure 8.**

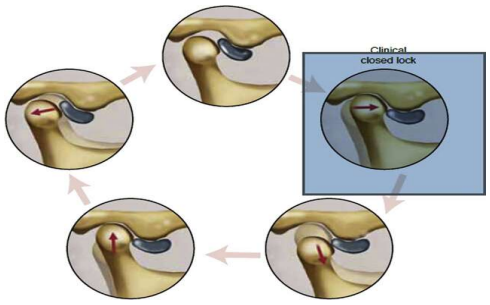

Fig. 8. Motion mechanics seen in temporomandibular joint with anteriorly displaced disc and resultant closed lock

The protocols for initial treatment consist of choosing reversible and little invasive therapies, such as occlusal splints, non-steroidal anti-inflammatory drugs (NSAID), analgesics, physiotherapy, thermotherapy, microcurrent, functional repose and patient advice.[53,54,55] However, in some cases, conservative treatment becomes little responsive due to current structural changes.1 Thus, more complex procedures such as intra-articular injections with corticosteroids or sodium hyaluronate, arthrocentesis, arthroscopy or open surgery for TMJ appear as therapeutic options to control and treat TMJ internal derangements.[51-57]

Glucocorticoids are yet the most effective anti-inflammatory drugs available, promoting symptomatic improvements of a series of clinical manifestations. However, they present risks of potential adverse effects which affect several organs depending on the dosage and, mainly, the duration of the treatment. For short periods (up to two weeks), even at high doses, the probability of causing adverse side effects is low. In long-term treatments, serious side effects appear, limiting the effectiveness of glucocorticoids in chronic diseases.[53,55] Glucocorticoids have a very original mechanism of action, essentially genomic (transcriptional) and characterized by the activation (transactivation) or inhibition (transrepression) of numerous target genes. These molecules act in many cells, including not only innate immunity cells (macrophages, granulocytes, mast cells) and adaptive immunity cells (lymphocytes), but also other cells (fibroblasts, epithelial and endothelial cells).[52,56]

Intra-articular injections with corticosteroids and sodium hyaluronate for treating temporomandibular joint disorders: A systematic revieworiginal articleosteoarthritis are observed in TMJ that have been treated and in contralateral TMJ that have not been treated, showing no statistically significant differences between sodium hyaluronate and corticosteroid. Moreover, they highlight the importance of assessments carried out by imaging examinations associated with clinical criteria in order to analyze the progression or regression of TMJ

osteoarthritis.[53-57]There are a variety of pharmacologic strategies that can be utilized in the management of TMD. Medication therapy is rarely utilized alone and is often used in conjunction with other modalities such as oral appliances and/or physical therapy. It is important the patient is aware that medical management provides improvement of symptoms, but not a cure .[53,52] Unfortunately, despite longstanding use of these therapies, there remains limited data to recommend one therapy over another[54,57].

In a 2010 Cochrane review article, it was noted that there is insufficient evidence regarding the effectiveness of medical management for TMD. [53[In this systematic review, eleven studies were included, however, a majority were excluded due to lack of a placebo group, insufficient reporting, and no clear diagnosis of TMD. [54]Several other systematic reviews, specific to pharmacologic interventions for TMD, report similar problems in study design leading to unclear conclusions regarding medication use [57,58]. For this reason, there is a need for well-conducted randomized control trials in the management of TMD with clear research objectives.[55,56,57,58]

Corticosteroids in oral and maxillofacial surgery;

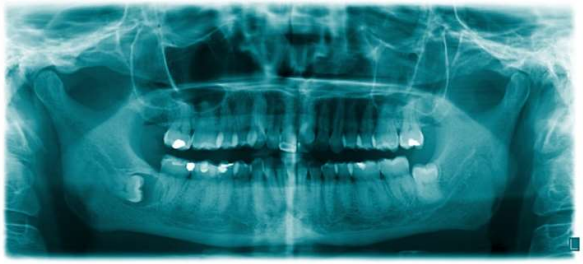

Figure 9; Removal of third molars is a very commonly performed operation and the post-operative period is often associated with pain, swelling and trismus. Steroidal and non-steroidal anti-inflammatory drugs have been widely used to control post-operative pain and swelling.

Corticosteroids are used mainly by oral and maxillofacial surgeons to reduce the post-operative sequelae (pain, swelling and trismus) of dentoalveolar surgery, orthognathic surgery, facial fractures and reconstructive surgery.[59] Post-operative nausea and vomiting have been reported to be less in patients who were given corticosteroids when these surgeries were done under general anaesthesia [18]. In addition, corticosteroids have been proven to improve interpalpebral width as well as reducing post-operative pain after surgical repair of orbital blowout fractures [19, 20,60]. Local steroid injection of the tongue base had proven to reduce the incidence and severity of post-palatoplasty upper airway obstruction in children undergoing cleft palate surgery [21,61]. A questionnaire survey in North America reported that close to half of oral and maxillofacial surgeons stated that they use short-term, high-dose perioperative corticosteroids to control post-operative oedema [22,62]. Only 20% of oral and maxillofacial surgeons claimed that they never use it for dentoalveolar surgery [23,62,63]. In comparison, corticosteroids are less preferred for dentoalveolar surgeries by surgeons in at least one European country [16,62]. Their popularity for dentoalveolar surgeries elsewhere has not been established.[61]

The group of corticosteroids of interest is the glucocorticoids (dexamethasone and betamethasone, and prednisolone and methylprednisolone), because of their anti-inflammatory activities with little or no effect on fluid and electrolyte balance [7]. Their effect has been well studied using the third molar surgery model over the past 6 decades . In a study that reviewed the reported outcome of corticosteroids over the last 10 years (2006–2015), Ngeow and Lim [7,64] reviewed 34 studies that administered corticosteroids via different routes which included intravenous, intramuscular (masseter, deltoid or gluteus), submucosal, endoalveolar and oral administrations. They found that benefits could be derived from the short-term use of corticosteroids with regards to pain, swelling and trismus control following third molar surgery, with no side effects observed. However, there were two limitations to their study, namely restriction to studies performed only throughout the last decade, and exclusion of studies that compared corticosteroids with other drugs, intervention or treatment, except when the corticosteroid was administered with an adjuvant therapy related to third molar surgery, namely an antibiotic. **Figure9.**

Some 10 years ago, a systematic review and meta-analysis by Markiewicz et al. [65] reported that perioperative administration of corticosteroids produced a mild to moderate reduction in swelling and improvement of trismus after third molar surgery. More recently, another three meta-analyses specifically reported on the effect of

dexamethasone in third molar surgery. Two reviewed the effect of submucosal injection of dexamethasone [25, 26], while the third reviewed the preemptive effect of dexamethasone [27]. The findings of two meta-analyses on submucosal injection are different. Chen et al. reported that submucosal injection of dexamethasone reduced not only early and late oedema but also early trismus [66], while Moraschini et al. reported that submucosal dexamethasone was effective in reducing pain and swelling, but not trismus [67]. The last meta-analysis looking solely on preemptive dexamethasone against other oral anti-inflammatories found that it is more effective than methylprednisolone for reducing swelling and trismus. However, the authors found insufficient evidence to conclude that dexamethasone is better than other nonsteroidal anti-inflammatories or methylprednisolone as a preemptive analgesic [68]. In term of mode of administration, it has been suggested that systemic administration of corticosteroids is more effective [8,65].

In conclusion, this systematic review suggests that despite the constraints, intra−joint and muscular corticosteroid injection appears to be an effective and safe treatment to improve pain and function in patients with any kind of TMD. More clinical trials are needed to confirm these conclusions.

TOPICAL CORTICOSTEROIDS IN ORAL PATHOLOGY

Topical corticosteroids are some of the most common drugs used in oral pathology for treating atrophic erosive lesions that affect the mucosa. These lesions often bleed and are painful; sometimes are chronic or have a high tendency to reappear and to interfere with very important activities such as eating, drinking, speaking or associating with other people. Severe erosive lesions of the oral mucosa have classically been treated with systemic corticosteroids, althoughthe adverse effects associated with the use of these drugs have conditioned the frequent prescription of topical corticosteroids for treating these pathologies.[70]

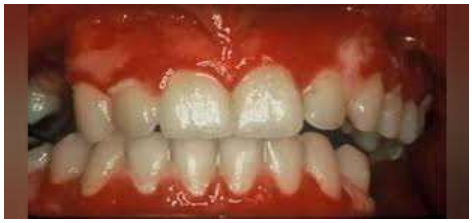

Figure 10. **Oral pemphigus vulgaris**

-Recurrent aphthous stomatitis;

These are superficial ulcers creating severe paid commonly occurring in the oral cavity. Ulcers which are less than one cm are considered to be minor form having 1-5 ulcers and they persist for one to two weeks and heal spontaneously without sequelae. The ulcers larger than 1 cm are considered as major aphthous ulcers and persist for months. In such cases, Corticosteroids either alone or in combinations with other drugs is administered for treatment based on severity. [70

Topical and injectable (intralesional) corticosteroids are useful for large and painful lesions. Systemic administration of corticosteroids is reserved for severe cases to prevent lesion formation or to reduce the number of lesions. Systemic corticosteroids should be prescribed in short courses, provided servere outbreaks or cases not respon, ding to injectable or topical corticosteroids.[71]

Central giant cell granuloma;

It is a lesion having benign tumor in jaws made up of loose fibrous connective tissue stroma most often occurs among young adults and children the characteristic of the tumor is with interspersed proliferating fibroblasts, aggregations of multinucleated giant cells and foci of hemorrhage. Both surgical and non-surgical treatments are administered based on the severity of lesion.[72,73] Intracellular corticosteroid injections are generally given for non-surgical treatment. Triamcinolone acetonide is found to be effective, and may act by suppressing any angiogenic component of the lesion.[74]

Pemphigus Vulgaris;

It is severe in nature and also potentially life threatening vesiculobullous disease. Oral cavity is involved in 80% of the patients affecting skin and mucous membranes. If not healed by corticosteroids, will be administered using systemic corticosteroids, with immunosuppressive agents, in order to achieve disease control with lower dose of steroids.[75] Systemic administration of corticosteroids at doses of 1-2 mg/kg/day is effective for principal treatment of pemphigus vulgaris. Topical corticosteroids can be given to maintain remission, allowing reduction in systemic dose. Isolated lesions can be treated with injectable corticosteroids.[75] **Figure 10**

Erythema Multiforme (EM) and Stevens-Johnson syndrome (SJS)'

It has been proved that corticosteroids are very effective on EM and SJS, if treated in high doses for a short time with proper tapering of dosages Treatment protocols such as early therapy by giving systemic prednisone (0.5 to 1.0 mg/kg/day or pulse methyl prednisolone (1mg/kg/day for 3 days), intravenous pulsed dose methyl prednisolone (3 consecutive daily infusions of 20-30 mg/kg to a maximum of 500 mg given over 2 to 3 hours), and dexamethasone pulse therapy (1.5mg/kg over 30-60 minutes on 3 consecutive days), all have been shown to be effective. [76]

Erythema multiforme;

Erythema multiforme is a blistering, ulcerative mucocutaneous condition of uncertain etiopathogenetic. The most common etiologic association with erythema multiforme is herpes simplex virus infection, which is frequently associated with the erythema multiforme flare.19It displays a wide range of clinical disease. In mild cases, ulcerations develop, affecting the oral mucosa. In severe cases, diffuse sloughing and ulceration of the entire skin and mucosal surfaces are seen. Early therapy begins with systemic prednisone (0.5to1.0 mg/kg/day) or pulse methylprednisolone (1 mg/kg/day for 3 days) has shown to be very effective.23 Intravenous (IV) pulsed dose methylprednisolone (3 consecutive daily infusions of 20 to 30 mg/kg to a maximum of 500 mg given over 2 to 3 hours) is reported, with the suggestion that this approach is superior to oral prednisone because it imparts the benefit when treatment is administered as early as possible in the progression of the cutaneous insult.[77,78]

Oral Lichen Planus;

Figure 11. Oral Lichen Planus

Lichen planus derives its name from similar lace-like pattern produced by symbiotic algae and fungal colonies found on surface of rocks, termed lichens. Lichen planus is a common chronic mucocutaneous disorder, which was first described clinically by Wilson in 1869 and histologically by Dubdreuilh in 1906.1 Oral lichen planus is commonly seen on buccal mucosa and vestibular areas followed by lateral borders of tongue and gingiva. The mean age at onset is in 4th to 5th decade of life, and common in females.2 At least one-third of patients with oral lesions also demonstrate cutaneous lesions. Clinically, it can appear in six different forms—reticular, papular, plaque-like, atrophic, erosive and bullous.[79]

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Multiple mechanisms are involved in the suppression of inflammation by corticosteroids, they include reduction of the exudation of leukocytes and plasma constituents, thereby lessening edema, maintenance of cellular membrane integrity with the consequent prevention of excessive swelling of the cells, inhibition of lysozyme

release from granulocytes, inhibition of phagocytosis, stabilization of the membranes of the intracellular lysozymes, which contain hydrolytic enzymes capable of cell digestion and extension of the inflammatory tissue damage. Corticosteroids also inhibit proliferation of fibroblasts with the positive effect of decreasing fibrosis.[81]

Figure 11

Topically, corticosteroid therapy is usually the treatment of choice initially, as it can be effectively delivered to the lesion surface with minimal potential for systemic side effects. Some agents used for topical application include 0.05% flucocinonide,0.05% clobetasol (Powercort®cream, Clobenol® cream),14 0.1 to 0.2% triamcinolone acetonide (Kenacort oral paste®, Cortrima® cream), dexamethosone and betamethasone valverate.[82]

Bell's palsy

With an unclear knowledge of the etiology of Bell's palsy, it poses a great challenge in coming up with an optimal treatment of the condition. To achieve a good outcome, corticosteroid needs to be given within 72 hours of onset of facial palsy. Berg et al. in 2012 found that prednisolone given within 72 hours of onset of palsy significantly improve outcome in mild to moderate palsy but not in severe palsy. The regime used was prednisolone 60 mg/day for 5 days, followed by 10 mg/day for another 5 days [84]. Using the same regimen, another study found that prednisolone significantly achieve complete recovery in mild to severe palsy and less synkinesis observed in mild and moderate palsy. However, no significant reduction of synkinesis in severe cases was reported [85]. Murthy and Saxena in 2011 suggested two corticosteroid regimens for the treatment of Bell's palsy which were either prednisolone 60 mg/day for 5 days followed by 10 mg/day for another 5 days or prednisolone 25 mg twice a day for 10 days [86]. The American Academy of Otolaryngology-Head and Neck Surgery recommended a 10-day course of oral steroids with at least 5 days at a high-dose (either prednisolone 50 mg for 10 days or prednisone 60 mg for 5 days with a 5-day taper) initiated within 72 hours of symptom onset [87]. Conflicting results were reported in different studies on the benefit of combining anti viral therapy with corticosteroid to achieve better outcome. Minnerop et al. reported that combination of famciclovir and prednisone was superior to prednisone alone in cases of severe Bell's palsy [88]. Combining antiviral therapy with prednisone increase the recovery rate slightly but not significantly compared to prednisone monotherapy [89]. On the other hand, valacyclovir was found to have no additional effect to prednisolone in sequelae of Bell's palsy [86] and the addition of acyclovir to prednisolone did not significantly improve recovery from Bell's palsy [90]. Despite conflicting results from various studies, Madhok et al. in their Cochrane review in 2016 concurred with current evidences that corticosteroids showed significant benefit in the treatment of Bell's palsy.[89]

Behcet's disease;

Behcet's disease is a multisystem, chronic relapsing inflammatory disease of unknown cause, which is characterized by recurrent oral (aphthous) ulcers, genital ulcers, uveitis and skin lesions. There may be a variety of other manifestations including joint, central nervous system, vascular and intestinal lesions of variable severity[81,90]

Patients with Behcet's disease usually have repeated exacerbations and remission of their clinical symptoms, and in these individuals, treatment is essentially symptomatic. The choice of therapy depends on whether the clinical manifestations of the disease are local or systemic.

Local treatment with corticosteroids often controls oral and genital ulcers, and immunosuppressive therapy is reserved for severe cases of mucocutaneous involvement.

Immunosuppressive therapy is the mainstay of treatment for Behcet's disease. Successful treatment consists of anti-inflammatory agents that modify neutrophil activity. In the acute phase, prednisone, at doses of 40-60 mg/day, may be helpful, used alone or in combination with other immunosuppressive agents.[90]

Systemic corticosteroids continue to be used extensively, and may be administered as intravenous pulse therapy.[91]

MUCOUS MEMBRANE PEMPHIGOID;

It is a chronic, autoimmune sub epithelial disease that primarily affects the mucous membrane of patients over the age of 50, resulting in blistering, ulceration and subsequent scarring. Topical corticosteroids and intralesional steroid injections are the main treatment modalities in mild oral disease. Potent fluorinated steroids such as fluocinonide 0.5% or Clobetasol propionate 0.05% (2–3 applications daily for 9–24 weeks) in an adhesive medium or used in a vacuum-formed customized tray or veneer for oral mucosal lesions are usually required.[81,82,87]

Ramsay Hunt Syndrome;

It is caused by the reactivation of varicella zoster virus infection. Management of these cases involves antiviral therapy and occasionally steroids. Steroid therapy is applicable for the facial paralysis in RHS. However, steroid therapy is given with caution as there exists fear of distribution of virus infection around the eyes.[90]

Post Herpetic Neuralgia;
This occurs after acute herpes zoster in the form of constant neuropathic pain in about 25% of patients. The constant triggering pain occurs due to the repetitive painful stimuli on the CNS resulting in central sensitization of the nociceptive system. Corticosteroids are used in such cases to treat pain and swelling and efficiently reduce PHN recurrence.[83,87,91] Glucocorticoids are unanimously used as the chief treatment option of giant cell arteritis. This should be used directly and hostilely for suppressing inflammation and preventing vision loss and ischemic attacks.[91,92] Corticosteroids (Prednisolone) are used, which help to treat pain, swelling, and decrease the risk of PHN recurrence. A moderate dose of prednisone 40 mg daily for 10 days, with slow taper in glover the following 3-week sisal efficient method to reduce PHN incidence. Steroids along with an antiviral for simple herpes zoster cases is debate. Steroids aid in resolution of acute neuritis and deliver an explicit development in the quality of life patients. Oral or epidural corticosteroids synchronously with antiviral therapy is efficiently used in treating moderate-to severe acute zoster, but does not affect PHN duration.[81,82,92]

Conclusion;

The current review highlights its uses, contraindications, side-effects as well as a guideline for its use in dentistry.

CONCLUSION

Corticosteroids are regarded as double-edged sword to the patients. Despite its various advantages, they also have severe side-effects. These drugs are one of the most misused drugs in the form of dosage. The current article highlights its various uses, side-effects, and contraindications in the oral and maxillofacial region as well as a guideline for its use in dentistry.

REVIEW ARTICLE
Corticosteroids in Dentistry
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Author Information
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Abstract
Steroids are one of the widely used drugs in dentistry. These are immunosuppressive agents. The reason for its use is its anti-inflammatory as well as immunosuppressive properties. Corticosteroids have revolutionized the management of several disabling conditions, but its use in term of dosage is inappropriate. The current review highlights its uses, contraindications, side-effects as well as a guideline for its use in dentistry.

Steroids are the substances that are naturally produced in our body. These are one of the widely prescribed drugs in both medical and dental sciences. Commonly used steroids are hydrocortisone, dexamethasone, methyl prednisolone, prednisolone, etc. Dental patients with a history of corticosteroid use may require special consideration before receiving any dental treatment. Currently, the misuse of steroids is its overdosage as it is prescribed even before minor dental procedures. The risks associated with excess glucocorticoid administration are relatively small.[1] These includes impaired electrolyte balance and hypertension.[2] The current review emphasizes on the uses and guidelines of use of corticosteroid in dentistry.

USES AND EFFECTS OF STEROID IN DENTISTRY

Endodontics

Steroids have shown its effects on root resorption.[3] In intracanal medicaments such as ledermix paste which reduces pulpal inflammation as well as root resorption. Further, zinc oxide eugenol along with steroids is also used as root canal sealer. In cavity liners, when steroid is mixed with chloramphenicol and gum caphor to reduce mainly postoperative thermal sensitivity.

Orthodontics

It is reported that the upon treatment with hydrocortisone at a dose of 10 mg/kg/day for 7 days on rats followed by observed for 20 h; the teeth showed a lower amount of tooth movement. Hence, it is essential that the patients are reviewed of their prior history of corticosteroids use.[4]

Oral surgery

Steroids are used after oral surgical procedures to limit postoperative inflammation. In 1974, Hooley and Hohl elaborated the use of steroid in the prevention of postoperative edema. He further concluded that topical use of steroid helps to prevent ulceration and excoriation which results during retraction during surgery over the lips and corners of the mouth.[1]

Oral medicine

In the treatment of various diseases as summarized.

Oral submucous fibrosis

Topical application of steroid applied over ulcerative or painful mucosa. The anti-inflammatory property of steroid shows a direct healing action on the mucosal patch.[5]

Oral lichen planus

A gingival tray can also be used to deliver 0.05% clobetasol propionate with 100,000 IU/ml of nystatin in orabase. Around 3–5 min application of this mixture daily appears to be effective in controlling erosive lichen planus.[6]

Erythema multiforme

Early therapy begins with systemic prednisone (0.5–1.0 mg/kg/day) or pulse methylprednisolone (1 mg/kg/day for 3 days).[7] Intravenous pulsed dose methylprednisolone (3 consecutive daily infusions of 20–30 mg/kg to a maximum of 500 mg given over 2–3 h) is reported, with the suggestion that this approach is superior to oral prednisone because it imparts the benefit when treatment is administered as early as possible in the progression of the cutaneous insult.[8]

Pemphigus vulgaris

Systemic steroids with other immunosuppressive agents are used. Pulse therapy is most commonly used. Each pulse is not standardized. 500–1000 mg prednisolone or 100–200 dexamethasone is given for each pulse.[9]

Bullous and mucous membrane pemphigoid

The mainstay of the treatment of pemphigoid is a moderate dose of corticosteroid. However, in severe cases, steroid-sparing agents are used. This includes clobetasol propionate 20–40 mg daily dose.[6]

Bell's palsy

Prednisolone 60–80 mg daily during 1st 5 days and taper over next 5 days.[10]

Central giant cell granuloma

Intracellular corticosteroid injections are used for nonsurgical treatment. Topically, triamcinolone acetonide can also be given as it suppresses an angiogenic component of the lesion.[11]

Post herpetic neuralgia

The systemic steroid is used to reduce the pain in these patients.[9]

Melkersson Rosenthal Syndrome

Due to anti-inflammatory action of steroid, it is used to reduce swelling and persistent edema. Short courses are preferred. Prednisolone in dose 1–1.5 mg/kg/day is given mainly. Tapering can be done further over 3–6 weeks depending on the severity as well as response.[12]

GUIDELINE FOR DENTAL USE

Current evidence reveals that the majority of patients with adrenal insufficiency can undergo routine, nonsurgical dental treatment without the need for supplemental glucocorticoids.[1314] This conclusion is supported by the fact that these dental procedures do not stimulate cortisol production at levels comparable to those oral surgical procedures,[15] and local anesthetic blocks neural stress pathways required for adrenocorticotropic hormone secretion.[16]

For patients undergoing general anesthesia for minor surgery 100 mg hydrocortisone intramuscularly should be administered and the usual glucocorticoid medications maintained. For major surgery 100 mg hydrocortisone delivered as a bolus preoperatively followed by 50 mg 8-hourly for 48 h is adequate.[17]

The major controversy resides for the patients who are undergoing any oral surgical procedures and had discontinued steroids recently**.** These are prescribed with supplemental steroid therapy. A conservative approach remains to wait 2 weeks for the normal adrenal function to return before performing elective oral surgical procedures.[181920] However, this conservative waiting period is not required for patients who are receiving 30 mg of hydrocortisone (that is, 5 mg of prednisone) or less per day.[21]

CONTRAINDICATIONS OF STEROIDS

Steroids may exacerbate the response in the following conditions. Therefore, these are contraindicated. In patients with:

Primary bacterial infection

Hypersensitivity

Peptic ulcer

Diabetes mellitus

Hypertension

Pregnancy

Osteoporosis

Herpes simplex infections

Psychosis

Epilepsy

Congestive heart failure

Renal failure.

SIDEEFFECTS

Sideeffects depend on duration for which steroids are given, dosage of the drug as well as approach it is used.

Systemic approach

In patients, suffering from primary hyperaldosteronism secondary to an adrenal adenoma and in patients treated with potent mineralocorticoids, it may cause hypokalemic alkalosis, edema as well as hypertension.[4]

Other side effects includes Cushing's habitus, skin atrophy, precipitation of diabetic myopathy, susceptibility to infection, delayed healing of wounds, peptic ulcers, osteoporosis, osteonecrosis, ophthalmic complications, growth retardation, fetal abnormalities, central nervous system complications, suppression of hypothalamic-pituitary-adrenal axis, effects on reproductive system, hyperlipidemia, weight gain, atherosclerosis, hypertension, malignancy.[4]

Topical approach

This approach causes adverse effects, such as skin atrophy, hypopigmentation contact dermatitis, oral thrush, subcutaneous fat wasting, and cushingoid effect.[22]

Inhalation approach

These include oropharyngeal candidiasis, dysphonia, reflex cough, bronchospasm, pharyngitis.[23]

Intralesional injections

This may lead to mucosal atrophy.[24]

MINIMIZE THE EFFECTS OF STEROID THERAPY

Probiotics play a crucial role in minimizing the effects of candidiasis when the patient is under steroid therapy. Probiotics act in three-ways. First, it inhibits pathogenic enteric bacteria. Second, it improves epithelial and mucosal barrier function by enhancing mucus production, increasing barrier integrity and by producing short chain fatty acids. Third, it alters immune regulation by stimulating secretory immunoglobulin a production, decreasing tumor necrosis factor expression, by inducing interleukin-10.[25]

CONCLUSION;

Corticosteroids are regarded as double-edged sword to the patients. Despite its various advantages, they also have severe side-effects. These drugs are one of the most misused drugs in the form of dosage. The current article highlights its various uses, side-effects, and contraindications in the oral and maxillofacial region as well as a guideline for its use in dentistry.

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Conflicts of interest

There are no conflicts of interest.

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