Abstract
Steroids have become widely used drugs in the field of medicine and dentistry. In recent years, in oral maxillofacial surgery, corticosteroids have been prescribed for functional and aesthetic purposes. Few decades ago, corticosteroids were used to control oedema and to decrease pain. They are used in select conditions with caution. Our review is on the use of steroids in various branches of medicine and dentistry.

Introduction
In the 1930s, prior to the use of steroids, scientists had created a synthetic form of testosterone (male sex hormone) to treat men who were unable to produce the hormone for normal growth and sexual function. In 1956, an American physician, Dr. Zeigler created a more selective form, known as anabolic steroids. Corticosteroids was first used in patients with rheumatoid arthritis in 1949 [1]. It was used in oral maxillofacial surgical procedures to minimize oedema, decrease pain and to promote neuro regeneration from the early 1960s to the late 1970s [1,2]. Steroids can be naturally occurring or manufactured synthetically. They influence entire organ systems of the body. It is produced from the adrenal cortex under the influence of ACTH (Adrenocorticotropic hormone), which is secreted day and night from the pituitary gland. The hypothalamus releases corticotropic releasing hormone (CRH) which regulates the secretion of ACTH by pituitary gland. The normal output of cortisol is 15 – 25mg/day, but during a state of crisis or stress, the body can release up to 300mg of cortisol. In oral &maxillofacial surgery, the normal dosage of methylprednisolone varies from 0-25mg. above these levels, the oedema can be minimized. Methylprednisolone ≥25mg or an equal dosage of other corticosteroids is effective against controlling oedema [3].

How do Steroids Act?
Corticosteroids secreted by the adrenal cortex are divided into 3 groups:

- Mineralocorticoids
- Glucocorticoids
- Endogenous testosterone

Sodium and potassium levels in the extracellular fluid are affected by the mineral corticoids. The blood glucose concentration is increased via glucocorticoids.

Corticosteroids inhibit the lysozyme induced membrane rupture which decreases the release of proteolytic enzymes and hyaluronidase, thereby controlling the oedema. It exhibits analgesic effect by inhibiting prostaglandin synthesis. Compression or trauma in nerve injuries can have direct or indirect effect on the nerves. Corticosteroids promote the healing of nerve injuries.

In tissue injury, the mediators of inflammation are released (prostaglandins, leukotrienes & thromboxane) through chemical and mechanical stimuli, which in turn activate the conversion of phospholipids to arachadionic acid, from the endothelium. These conversion processes take place in the presence of phospholipase.

The sequelae of action of steroids at the cellular level starts with inhibition of mast cell production and nuclear cytokine, kinine and histamine thereby facilitating inhibition of thromboxane and bradykinin which causes a decrease in dilatation and permeability of blood vessels.

In our review, the benefits and side effects of steroids have been evaluated in an elaborate manner. The pre-, intra- and post-operative dosages of corticosteroids have been highlighted. The absorption of corticosteroids depends mainly on the blood supply of the area that the drug has been injected. Pre-operative administration of steroids is more effective than the post-operative administration and lastly the submucosal route of administration has similar effects that of the intravenous (IV) and intramuscular (IM) route [5].

Corticosteroids can prevent the release of mediators of inflammation and therefore reduce the inflammation at the surgical site and nowadays they have been widely used to reduce the incidence of post-operative sequelae of surgeries.

Long term usage of steroids affect the endogenous corticosteroid production and suppress the hypothalamus pituitary adrenal (HPA) axis [6].

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Clinical application

Steroids Used for Treating Viral Infections

It is used for upper respiratory obstructions in children from the age of 6 months to 6 years. Management for these conditions varied from the use of humidified oxygen to epinephrine. Corticosteroids have been used for this condition for the past 30 years. Recent studies have shown that 0.6mg/kg of dexamethasone (IM) is very useful in treating upper respiratory infections of viral origin [7].

Pneumocystis jiroveci pneumonia

HIV patients have mostly been affected by pneumocystis jirovecipneumonia which has caused high mortality & morbidity. Favourable clinical results have been obtained by the usage of corticosteroids as an adjunctive treatment for pneumocystis jirovecipneumonia in the late 1980s. The National Institute of Health has endorsed this therapy as a standard procedure. Oral dosage of prednisolone 40mg for 5 days and 20mg daily have been advocated for the treatment of pneumocystis jirovecipneumonia [8, 9,10].

Hyperthyroidism

Hyperthyroidism is a common condition affecting the thyroid gland, around 2% women and 0.2% of men are affected [11]. Hyperthyroidism is caused by Grave's disease, toxic nodular goitre, toxic adenoma, acute thyroiditis and thyroid storm. For treating hyperthyroidism, dexamethasone 2mg IV administered every 6 hours changed to oral drugs every 6 hours has been proven to show good results [12].

Pain Management

Cancer related pain, herpes zoster related neuropathy, and spinal cord compression and post-operative cases of oral & maxillofacial surgery have been treated with an adjuvant analgesic of corticosteroids. Dosage of 40 – 80mg / day can be used pre-operatively in third molar surgeries following which oedema, pain and trismus have been well controlled [13,14].

Steroids in oral & Maxillofacial Surgery

The outcome of the usage of steroids in surgical removal of impacted third molar by various studies has been summarized below.

Steroids in Oral & Maxillofacial Pathology

Cicatricial Pemphigoid

Uncommon autoimmune disease which affects mucosal surfaces of oral cavity, larynx, oesophagus, upper respiratory tract, genitalia and conjunctiva, skin. Women are affected in this condition. Bullous nature of the disease affects the men. No predilection for men or women [15].

Management: 0.1% - 0.5 % triamcinolone aqueous rinse or ointment when wide spread lesion is seen. Custom made acrylic trays to hold the ointment in particulars area like gingival may be used. In more extensive case burst regimens is used [16, 17].

- 40mg / morning / 1 ½ hours / five days
- 20mg / morning / 1 ½ hours / 2 to 3 weeks

Central Giant Cell Granuloma

Benign aggressive lesion which is most commonly treated surgically. It appears as multiple lesions which is of two types central and peripheral giant cell granuloma [18].

Management

Surgical or conservative treatment is used for the treatment of central giant cell granuloma. Surgical resection, enblock resection, curettage and enucleation were the treatment of choice till 1988. Jacoway et al. described an alternative treatment of injection steroid inside the lesions. This seems to be the successful treatment than surgical aspect [19].

Osteoradionecrosis of jaw

Marx in 2003 first described osteonecrosis (ONJ) [20] as a side effect of bisphosphonate (BP). The use of zoledronic acid, the 3rd generation nitrogen containing bisphosphonate to treat malignancy with monthly dosage of 4mg IV, is a very potent drug and can cause ONJ in a year.

Management: Pentoxiphylline (PEN) issued in treating vascular diseases (ischemic heart diseases) which improves peripheral blood flow, vasodilation, antitumor necrosis factor. Tocopherol (TO) is apotent scavenger of oxygen radicals. Antioxidant property inhibits platelet aggregation. It also impairs tissue fibrosis. PEN has been shown effective treatment in osteoradionecrosis and the duration of treatment varies from 6 to 24 months [21].

Langerhans Cell Histiocytosis

It is characterized by the accumulation of proliferative langerhanscells [22, 23]. It is derived from bone marrow, epidermis, thymus and mucosa. In bones it may affect single or multiple bones. In children the skull and the mandible are mostly affected. In adult vertebra, long bones are frequently affected. Incidence rate is high in the 3rd decade and men are twice more prone to the disease. Surgical, radiotherapy, chemotherapy have lasting side effects on patients, but intraleisional use of steroid (Methylprednisolone) seems to be the initial treatment of choice. It is non-invasive, more cost effective and avoids systemic side effects. It is easy to administer.

Steroids in Orthognathic Surgery

Post operative nausea and vomiting is the most frequent and distressing complication in our patients and inpatients alike. Patient's have more concerns about post-operative nausea and vomiting than post-operative pain and anaesthetic drug effect [24]. Post-operative nausea and vomiting is linked to many types of surgeries like ophthalmology, laparoscopic and gynaecological surgeries, orthopaedic surgery. Patients develop post-operative nausea and vomiting within 24 hours of surgery, particularly after bimaxillary osteotomy which has an incidence of 56%. During osteotomies of the maxilla and the mandible, patients experience high risk of nausea and vomiting compared to the simple osteotomy. Greater the duration of the surgery, greater the risk of post-operative nausea & vomiting. Females are more commonly affected. The other risk factors are increased IV fluids usage, use of nitrous oxide, increased
duration of surgery time, morphine administration.

Management during vomiting the gastrointestinal tract and vagal afferent activate the vomiting centre by stimulation of 5-HT3 receptor vestibule system. They respond to motion. The use of steroids in orthognathic surgery post operatively prevents post-operative nausea & vomiting by depleting 5-HT3 in neural tissues and preventing its release in the gut. A single dose of Dexamethasone 8 mg in the prevention of post-operative nausea & vomiting is less effective when compared to a single drug regimen of 5-HT3 receptor antagonist [25].

**Adverse Effects**

Adverse effects are dose related and predictable according to the glucocorticoids and mineral corticoid actions.

**Conclusion**

Steroid potency is a common point of endless discussion. In steroids tabulations have been made on favourite table lists or references of potency ranking, which divides the steroid group into broad categories. The use of steroids in maxillofacial surgery varies from minor procedures to major procedure (Impaction– orthognathic surgery). Reduction of pain, trismus and swelling is compromised pre-operatively using steroids. Post-operative nausea, vomiting is controlled by the action of steroids during long duration of bimaxillary surgeries.

### Table 1: Type and Potency of Glucocorticoids & Duration of Corticosteroids

<table>
<thead>
<tr>
<th>Drug</th>
<th>Type</th>
<th>Duration of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dexamethasone</td>
<td>Long acting</td>
<td>&lt; 12 hours</td>
</tr>
<tr>
<td>Prednisone</td>
<td>Intermittent acting</td>
<td>12 -36 hours</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>Intermediate acting</td>
<td>12 -36 hours</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>Short acting</td>
<td>&gt; 36 hours</td>
</tr>
</tbody>
</table>

In chew and spit method for treatment of oral lesions has been followed which is very effective during the long term follow up of the patient. The absorption of the steroid from the oral erosive lesion is much more greater than the skin. We can expect systemic adverse effects of the drug. Topical use of steroids is much safer than the systemic steroids.

HPA axis suppression and delayed wound healing are minimized risk when steroids are used for a minimum of 3 days to a maximum of 5 days for beneficial activities of the drug. Single dose of steroids can act for longer durations, so in case of post-operative oedema in 48 – 72 hours which peaks up, it is well controlled.

Further studies have to be postulated regarding the use of steroids in trauma and third molar impaction, orthognathic surgery, TMD (Tempromandibular joint disorder), oral vesicular lesions and desquamative lesions of the oral cavity.

### Table 2

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of steroids</th>
<th>Inference &amp; results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hooley &amp; Francis 1964</td>
<td>Oral dexamethasone one hour before surgery</td>
<td>↓ Oedema, lesser usage of analgesics after surgery, pain reduced considerably</td>
</tr>
<tr>
<td>Messer &amp; Keller 1975</td>
<td>Dexamethasone 4mg IM</td>
<td>↓ Swelling ↓ Trismus Reduced post-operative pain</td>
</tr>
<tr>
<td>Huffman 1977</td>
<td>125mg IV methylprednisolone Before surgery 40mg methylprednisolone immediate Pre –Op</td>
<td>No difference for period of one week Reduced swelling, trismus, pain</td>
</tr>
<tr>
<td>Hargreaves &amp; Costello</td>
<td>125mg methylprednisolone</td>
<td>3 hours after surgery – reduced immune active bradykinin</td>
</tr>
<tr>
<td>Skjelbred &amp; Lokken 1985</td>
<td>9mg IM betamethasone</td>
<td>3 hours after surgery – 3rd post-operated day, 55% swelling reduced 6th post-operated day reduced swelling</td>
</tr>
<tr>
<td>Elhagetal 1985</td>
<td>10mg dexamethasone</td>
<td>Swelling and trismus reduced 1 hour pre-operatively Reduced pain 10-18 hours post-operatively</td>
</tr>
<tr>
<td>Pederson 1985</td>
<td>4mg IM dexamethasone</td>
<td>Pre-operative - reduced swelling on 2nd post-operative day No change in swelling on 7th post-operative day</td>
</tr>
<tr>
<td>Miller &amp; Desjardins 1993</td>
<td>20mg methylprednisone– single dose</td>
<td>1st post-operated day – swelling reduced – 42% 2nd post operative day - swelling reduced - 34% 3rd post operative day - swelling reduced - 19%</td>
</tr>
<tr>
<td>Sisk &amp; Bennington 1985</td>
<td>125 mg IV methylprednisolone pre-operatively</td>
<td>Swelling, pain &amp; trismus reduced</td>
</tr>
<tr>
<td>Beirne &amp; Hollander</td>
<td>12mg methylprednisolone Before surgery</td>
<td>Increased swelling on 2nd and 3rd day</td>
</tr>
</tbody>
</table>
Neupert et al. 1992 | 4 mg dexamethasone post-operative | Reduced pain, trismus No difference in swelling

Schmelzeisen & Frolic | 6 mg dexamethasone oral administration pre-operative 12 hour before and after surgery | 37% reduced post-operative pain 54.3% reduced swelling 17.7% reduced trismus 50% reduced pain

Baxendale et al. 1993 | 8 mg dexamethasone post-operative | Reduced pain post-operatively No effect on trismus and swelling

Esen et al. 1999 | Methylprednisolone Sodium succinate | Post-operative injection showed normal HPA axis Before and after Methylprednisolone administration by ACTH indicator. Reduced swelling, trismus, pain

Gross et al. 1993 | 4 mg dexamethasone | Intraoral injection pre-operatively Reduces post-operative oedema

Jose Rodrigues et al. | 8 mg dexamethasone 4 mg dexamethasone post-operatively | Post-operative complication less in 8 mg group Patient than in 4 mg group

Klongnoi | 8 mg IM dexamethasone – 1 hour Pre-operative | Reduced swelling 2nd and 7th Post-operative No significant changes Reduced pain on 2nd & 7th Post-operative day No difference in trismus

Vegas – Bustamante | 40 mg methylprednisolone Intra masseter (Immediate Post-operative) | Reduced swelling, pain and trismus

### Table 3

<table>
<thead>
<tr>
<th>Risk with short term steroid usage</th>
<th>Risk with long term steroid usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggravation of hypertension</td>
<td>HPA axis suppression Hypokalemia</td>
</tr>
<tr>
<td>Fluid retention (oedema)</td>
<td>Metabolic alkalosis</td>
</tr>
<tr>
<td>Gastritis</td>
<td>Oedema</td>
</tr>
<tr>
<td>Stress ulcers</td>
<td>Weight gain</td>
</tr>
<tr>
<td>GIS bleeding</td>
<td>Hyperglycemia</td>
</tr>
<tr>
<td>Silent perforation</td>
<td>Redistribution of body fat (Buffalo hump)</td>
</tr>
<tr>
<td>Psychiatric disturbances (Euphoria psychosis, apathy and lethargy)</td>
<td>Proximal skeletal muscle myopathy</td>
</tr>
<tr>
<td>Delayed &amp; abnormal wound healing</td>
<td>Post –traumatic avascular osteonecrosis</td>
</tr>
<tr>
<td>Osteopenia</td>
<td>Ophthalmic changes</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>Cataracts (More common in children)</td>
</tr>
<tr>
<td>Increased susceptibility to infection</td>
<td>Elevation of intraocular pressure</td>
</tr>
<tr>
<td>Decreased glucose tolerance</td>
<td>Glaucoma</td>
</tr>
<tr>
<td>Hyperglycemia</td>
<td></td>
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References