

“Oral Cavity its Problems and Solutions”

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Abstract:

Buccal drug delivery has attracted a lot of interest and momentum since it provides outstanding benefits. Because it is simple to administer, the oral cavity is a desirable location for drug delivery because it prevents first pass metabolism and potential drug degradation in the gastrointestinal tract. The buccal dosage forms are meant to be placed between gingival and cheek. Mucoadhesive polymers are used to improve drug delivery by enhancing the dosage forms contact time and residence time with the mucous membrane. The term "oral health" describes the condition of the teeth, gums, and overall oral-facial system, which enables us to chew, speak, and smile. Some of the most common diseases that impact our oral health include cavities (tooth decay) , gum diseases (periodontal) and oral cancer. Buccal dosage form includes tablets, patches, gels, liquids. The aim of the review article is an overview of problems of oral cavity, cosmetic view, dosage forms/ devices and their APIs and materials, local anaesthetic techniques.

Key Words: Buccal Drug Delivery, Mouth Ulcers, Oral Cancer, Local Anaesthesia.

1. Introduction

Significant interest has been shown recently in the development of new bioadhesive dosage forms for mucosal drug delivery[1]. The oral cavity is easily assessable for self medication and the administration drug is to be promptly terminated in case of toxicity by removing the dosage form from buccal cavity. The oral route is the one that patients most often choose among the several drug delivery methods. There are different varieties of the oral route of medication delivery, but this route also has significant drawbacks such hepatic first pass metabolism and enzymatic degradation in the GI tract[2]. For example, buccal administration prevents and eliminates the first pass effect in the gastrointestinal tract, has a more favourable enzymatic environment for the absorption of some drugs, is inexpensive, and is simple to administer to patients of all ages, including those with intellectual disabilities. Drugs absorbed by the highly vascularized mouth mucosa directly enter the systemic circulation[3]. Buccal cavity was found to be the most convenient and easily accessible site for both local and systemic delivery[4]. Dental caries, oral candidiasis, oral lesions, and gingivitis are among disorders that can be treated locally and xerostoma where as systemic delivery carries the drug into the main circulation avoiding first pass metabolism effects. Formulation can be removed if therapy is required to be discontinued[5]. Buccal adhesive drug delivery prolong the residence time of the dosage form at the site of application or absorption and facilitate an intimate contact of the dosage form with the absorption surface and thus contribute to improved therapeutic performance

of drug[4]. Drug absorption through mucosal surface is efficient because mucosal surfaces are usually rich in blood supply[6].

2. Anatomy of Oral Cavity

The oral cavity reaches from the vermilion border of the lips inferiorly to the junction of the hard and soft palate, and superiorly to the circumvallate papillae of the tongue. The lip, oral tongue, floor of the mouth, buccal mucosa, upper and lower gum, retromolar trigone, and hard palate are among the anatomical subsites of the oral cavity (Figure 1).[7].

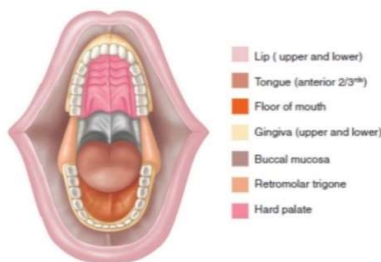


Figure 1. Oral Cavity

The oral mucosa is composed of an stratified squamous epithelium (about 40-50 layers thick), a lamina propria followed by the sub mucosa as the innermost layer[8]. Three distinctive layer of the oral mucosa are the epithelium, basement membrane, and connective tissues (lamina propria), oral cavity is lined with the epithelium, below which lies the supporting basement membrane. The basement membrane is in turn supported by connective tissues.[9].

2.1 Permeability

Buccal mucosa has a 4–4000 times higher permeability than skin. due to the various structures and functions of the various oral cavity regions[10]. Sublingual is more permeable than buccal and buccal is more permeable than palatal, in that order. This is based on the relative thickness and degree of keratinization of these tissues with the sublingual mucosa being relatively thin and degree of keratinized, the Buccal mucosa is thicker and non keratinized and the palatal intermediate in thickness but keratinized[11].




3. Problems of Oral Cavity:


Some of the diseases that impact our oral health include Mouth Ulcers, Oral Cancer.

3.1. Mouth Ulcers

Table 1. Types of Oral Ulcers

Sr no	Types of Oral Ulcers	Pictures



1	<p>Acute Ulcers [12].</p> <p>Traumatic ulcers:</p> <p>The oral mucosa is frequently subjected to physical, thermal, or chemical trauma that damages the tissue and leads to ulceration. Regular actions like dental brushing and flossing, can cause this.</p>	 <p>Figure 2. a) Traumatic ulcer due to brush injury, b) Traumatic ulcer due to sharp tooth</p>
3	<p>Erythema multiforme [12].</p> <p>An acute, self-limiting mucocutaneous condition that affects the skin and frequently the oral mucosa is called erythema multiforme (EM). Type III and IV hypersensitivity reactions are thought to be the etiopathogenesis, and they can be triggered by a number of things, including infections like HSV, medication reactions to NSAIDs or anticonvulsants, sulphonamides, and antibiotics.</p>	 <p>Figure 3. Bloody crustations in lips in erythema multiforme</p>
4	<p>Chronic Ulcers[13].</p> <p>Bacterial: Syphilis and Tuberculosis: <i>Treponema pallidum</i> is the sexually transmitted pathogen that causes syphilis. The chancre often appears in the oral cavity as a deep, single ulceration that can be uncomfortable. The lips are the most typical site of involvement, with the tongue, palate, and tonsils being less frequent locations. Usually, oral chancres involute in 3 to 8 weeks.</p>	 <p>Figure 4. Bacterial ulceration. Syphilitic ulceration of the soft palate</p>


<p>5</p>	<p>Mucous membrane pemphigoid [14].</p> <p>Bullae that easily rupture and cause a highly painful ulcerated area appear in the oral mucosa as a result of MMP development. The most commonly involved areas are the palate and gingiva, commonly in the form of chronic desquamative gingivitis.</p>	 <p>Figure 5. Mucous membrane pemphigoid: ulcer on the soft palate</p>
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3.2. Oral Cancer

Oral cancer is a malignant neoplasia which arises on the lip or oral cavity. Is traditionally defined as a squamous cell carcinoma (OSCC), because in the dental area, 90% of cancer are histologically originated in the squamous cells. It has different levels of differentiation and a propensity for lymph node metastasis[15].

Table 2. Types of Oral Cancer

Sr no	Types[7].	Picture
<p>1</p>	<p>Squamous cell carcinomas (SCC):</p> <p>One of the most prevalent oral malignancies is squamous cell carcinoma of the tongue, with the majority of cases developing on the lateral edge of the tongue. Especially near the midline, SCC of the tongue dorsum is quite uncommon[9].</p>	 <p>Figure 6. Squamous cell carcinomas</p>
<p>2</p>	<p>Leukoplakia:</p> <p>Leukoplakia is a clinical term defined as a “white patch or plaque that cannot be characterized clinically or pathologically as any other disease”. This lesion is usually associated with smoking and alcohol use[9].</p>	 <p>Figure 7. Leukoplakia</p>


<p>3</p>	<p>Erythroplakia:</p> <p>Erythroplakia is a “bright red velvety patch that cannot be characterized clinically or pathologically as being caused by any other condition”. Surgical excision is recommended as these lesions have higher malignant potential than leukoplakia and are commonly associated with dysplasia and carcinoma in situ[9].</p>	 <p>Figure 8. Erythroplakia</p>
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The following tests may be used to diagnose oral Cancer:

- Physical examination.
- Endoscopy.
- Biopsy.
- Oral brush biopsy.
- X-ray.
- Computed tomography (CT or CAT) scan.
- Magnetic resonance imaging (MRI).

4. Tooth Problems

Table 3. Tooth Problems

Tooth problems [16].	Description	Pictures
Tooth Cavities	Tooth Cavities also called as tooth decay or dental caries, develop when a sticky colorless-to-yellow film of bacteria called plaque forms on the tooth's surface.	 <p>Figure 10. Tooth Cavities</p>

<p>Gum Disease</p>	<p>Mild gum disease, called gingivitis, occurs when plaque accumulates between and around teeth and infects the gums, causing irritation and swelling. Gingivitis can cause bleeding gums, painful chewing, receding gums, and tooth loss. Gingivitis can progress to periodontitis.</p>	 <p>Figure 11. Gingivitis</p>  <p>Figure 12. Periodontitis</p>
<p>Tooth Erosion</p>	<p>Tooth erosion occurs when food acids cause enamel to erode, much like tooth decay does. Acidic and sugary diets can encourage dental deterioration.</p>	 <p>Figure 13. Tooth Erosion</p>

5. Cosmetic View[17].

Any dental work that enhances the appearance of teeth, gums, and other dental structures is often referred to as cosmetic dentistry. It generally focuses on Dentifrices are preparations for external use that clean the teeth and the area around them, cleanse and refresh the inside of the mouth, prevent dental caries and periodontal disease, and mouth fresheners are preparations taken internally to prevent nausea and other uncomfortable feelings. These two categories can be used to classify oral care cosmetics.



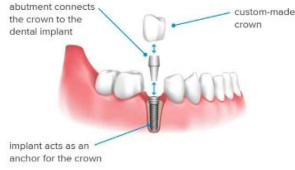
Table 4. Categories of oral cleansing product


Forms	Ingredients	Features
Tooth Powders (Dentifrice)	Agents that are abrasive, foamy, flavorful, or medicinal.	Abrasive at least 95%.
Moist Tooth Powders (Dentifrice)	Agents for abrasion, wetting, foaming, flavouring, and pharmaceuticals.	Abrasive around 70%.
Toothpaste (Dentifrice)	Agents for abrasion, wetting, binding, foaming, flavouring, pharmaceuticals, etc.	Abrasive 60% or less.
Liquid-form dentifrice	Agents for wetting, binding, foaming, flavouring, pharmaceuticals, etc.	Contains no abrasive.
Mouthwash	Pharmaceutical agent, flavouring, wetting agent, solubilizing agent, solvent, etc.	Used as liquid. Direct use, concentrated, and powder varieties are available.

Table 5. Different types of mouthwash

Type	Usage	Features
Directly used type	This type is used as it is.	Very convenient to use ; currently the most used type.
Concentrated type	The base solution is diluted with a fixed amount of water when used	Compact and light ; the mouth may be washed many times with the contents of one bottle.
Powder type	The powder is dissolved in a fixed amount of water when used.	Easy to carry around.



Table 6. Cosmetic View



Sr.no	Cosmetic View	Description	Photo
1	Smile Design[18].	<p>The term "smile design" refers to a variety of scientific and artistic ideas that, when combined, can produce a stunning smile. Data gathered from patients, diagnostic models, dental research, scientific measurements, and fundamental artistic notions of beauty are used to establish these principles.</p>	 <p>Figure 14. Smile Designing</p>
3	Tooth Fragment attachment[19].	<p>Nearly all dental professionals are familiar with patients who come to their regular office with traumatised teeth. Due to their anterior positioning and projection, maxillary incisors are the teeth most commonly afflicted. Crown or crown root fractures are caused by trauma from falls, collisions with other objects, contact sports, and traffic accidents.</p>	 <p>Figure 15. Tooth Fragment Attachment</p>
4	Implants[20].	<p>A dental implant is a structure that acts as a tooth replacement. With screw like devices, the surgeon inserts an implant into the jawbone, and it acts as an anchor for an artificial tooth, called a crown.</p>	 <p>Figure 16. Dental Implants</p>

5	Dentures[21].	Dentures are artificial teeth-replacing devices that are held in place by the surrounding soft and hard tissues of the oral cavity.	 <p data-bbox="956 380 1216 411">Figure 17. Dentures</p>
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6. Crowns[22,23,24].

Table 7. Types of Crowns

Sr.no	Types of Crowns	Description	Photos
1	Stainless Steel Crown	For reconstructing severely carious and shattered primary incisors, stainless steel crowns are regarded as the most dependable, affordable, and long-lasting option. They are simple to put, unbreakable, durable, and firmly adhered to the tooth till exfoliation. Due to the unsightly silver metallic appearance, there is a compromise in aesthetics.	 <p data-bbox="987 1052 1318 1115">Figure 18. Stainless Steel Crown</p>
4	Pedo Jacket	This tooth-colored copolyester material has a resin fill and is left on the tooth after polymerization rather than being taken off. It doesn't crack, discolour, or split. With scissors, crowns are readily trimmed.	 <p data-bbox="1003 1465 1302 1497">Figure 19. Pedo Jacket</p>

6	Gold	<p>In real, gold crowns are made of copper mixed with other metals like nickel or chromium. the main advantage of gold crown is their strength and durability.</p>	 <p>Figure 20. Gold</p>
7	Diamond	<p>Only Diamond Crown, a Poly-Crystalline Nano Ceram material, is strong enough to hold a 5-unit bridge devoid of alloy reinforcement. Diamond crown is a fantastic option for persons with metal allergies or other sensitivities due to its incredibly high biocompatibility.</p>	 <p>Figure 21. Diamond</p>

7. Dental X-Ray [25].

Orthopantomogram or Dental x-ray machines are frequently used to perform teeth radiography. Dental X-ray machines are used to provide a clear view of the internal radiolucent areas and to conduct better diagnosis and treatment.






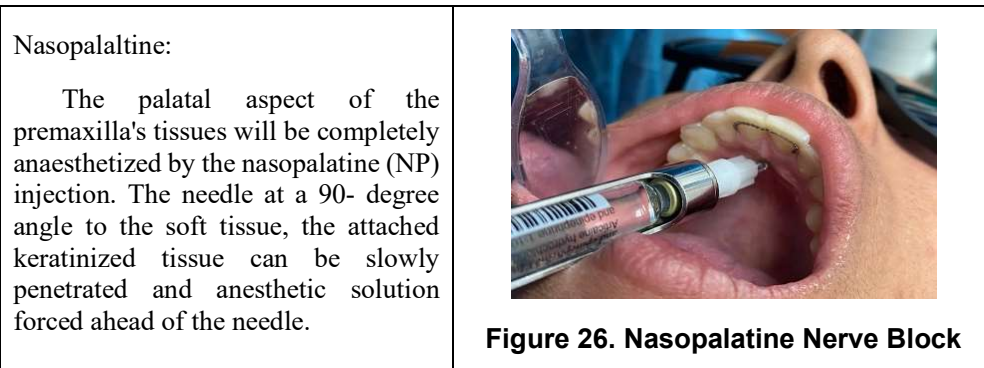
Figure 22. Orthopantomogram

8. Local Anesthesia and Techniques[26].

The core of pain management strategies used by dentists is local anaesthetic. Local anesthetics represent the safest and most effective method for managing pain associated with dental treatment.

Table 9. Local Anesthetics.

Types of local anesthesia	Pictures
<p>Posterior Superior Alveolar:</p> <p>The maxillary molars will be put to sleep by a injection in the posterior superior alveolar region. The periodontal ligament (PDL), bone, periosteum, and buccal soft tissue adjacent to these teeth are also anesthetized. At about a 45-degree angle to the mesiodistal and buccolingual planes, the needle is inserted distally and superiorly. The insertion depth is roughly 15 mm.</p>	 <p>Figure 23. Posterior Superior Alveolar Nerve Block</p>
<p>Middle superior alveolar:</p> <p>After receiving the middle superior alveolar (MSA) injection, the premolars, PDL, buccal bone, periosteum, and the soft tissue lateral to this area will all be anaesthetized. The mesiobuccal section of the maxillary first molar will also be. The height of the buccal vestibule, to the side of the maxillary second premolar, is the penetration point for the MSA injection. The tooth's apex should be roughly where the needle tip is. This typically requires a penetration of about 5 mm.</p>	 <p>Figure 24. Middle Superior Alveolar Nerve Block</p>
<p>Greater Palatine:</p> <p>Greater palatine (GP) injections anaesthetize the hard palate's tissues from their most distal aspect anteriorly to the canine's distal end and laterally to the midline. The depth of penetration is variable, but usually less than 5 mm is sufficient.</p>	 <p>Figure 25. Greater Palatine Nerve Block</p>



9. Root Canal [27].

Root canal treatment (endodontics) is a dental procedure used to treat infection at the centre of the teeth. Root canal is not painful and can save the tooth that might otherwise have to be remove completely.



Figure 9. Root Canal Before and After

10. Novel Approach

10.1. Mucoadhesion

Mucoadhesion is the term used to describe the process where a biological substrate adheres to a mucosal layer. By lengthening the dosage form's contact with the mucosal membrane and its stay there, mucoadhesive polymers are utilised to increase drug delivery[8]

Polymers For Mucoadhesive Drug Delivery:

Hydrophilic polymers: PVP (Poly vinyl pyrrolidine), MC (Methyl cellulose),SCMC (Sodium carboxyl methyl cellulose),HPC (Hydroxyl propyl cellulose),Anionic polymers - carbopol, polyacrylates, Cationic polymers – chitosan, non-ionic polymers - eudragit analogues.

Table 8. Dosage Forms/Devices [9].

Dosage Forms/ Devices	API/Materials	Role
Tablets	Quetiapine Fumarate Propranolol tartrate Rapaglinide Acyclovir Flurbiprofen Itraconazole Piroxicam Miconazole nitrate	Antipsychotic Anti-Hypertensive Anti-diabetic Anti-Viral NSAIDs Antifungal NSAIDs Antifungal
Gels	Lignocaine Itraconazole Nystatin	Local anesthetics Antifungal Antifungal
Patches/Films(NDDS)	Hydrochlorothiazide Miconazole Methotrexate Atenolol Ibuprofen Cetylpyridium chloride Metoprolol tartrate Aceclofenac Glipizide Glyburide Ranitidine Terbutaline sulphate Ketorolac Flufenamic acid	Diuretics Antifungal Antimetabolites Beta blockers NSAIDs Antifungal Beta blocker NSAIDs Antidiabetic Antidiabetic Antacid Beta agonists NSAIDs NSAIDs
Implants	Metals Ceramics	to make someone's appearance or chewing.
Crowns	Metals Porcelain Resin Ceramics	When fillings are insufficient to address the issue, crowns are utilised to protect, cover, and correct the shape of your teeth.

11. Evaluation Parameters of the Buccal Formulations

1. Surface PH[28].
2. Swelling Index[28].
3. Thickness measurements[29].
4. Folding endurance[29].
5. Ex-vivo mucoadhesive strength[30].
6. Moisture Absorption[31].
7. In vitro Drug Release[32].
8. Permeation study of buccal patch[33].

12. Advantages

1. bypass the first-pass effect and avoid the medications coming in contact with the digestive juices.
2. many medications' performance can be improved. As they are having prolonged contact time with the mucosa[9].
3. The drug can be administered in unconscious & trauma patient.
4. It has rapid onset of action.
5. There is flexibility in physical state, shape, surface & size[34].
6. The drug release for the prolonged period of time[34].

13. Disadvantages[4].

1. Large dosage medications are difficult to give.
2. A drug cannot be administered if the buccal pH is unstable.
3. Swallowing of saliva can also potentially lead to loss of dissolved or suspended drug.
4. As compared to the sublingual membrane, the buccal membrane has a low permeability.
5. Drugs which irritate oral mucosa or have bitter taste, or cause allergic reactions, discoloration of teeth cannot be formulated.

14. Conclusion

During the last few years research on buccal drug delivery has revealed considerable growth and advances. If low drug concentrations are required to gain access to the blood, the buccal route may be very satisfactory. Drug distribution for both local and systemic therapy is made possible via buccal mucosa. The sixth-largest category of malignancies in humans is mouth cancer. The prevention or reduction in the use of tobacco products and alcohol consumption would have a profound influence on the incidence of oral cancer. Ulcers are common in the oral cavity, it is responsibility of the dentist to look into such lesions even during regular visits, counsel the patients and plan the treatment accordingly.

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