A COMPARATIVE STUDY FOR ASSESMENT OF PAIN RELIEF IN RECURRENT APHTHOUS ULCER BY USE OF DIODE LASER & TRIAMCINOLONE ACETONIDE 0.1% THERAPY

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In

ORAL MEDICINE AND RADIOLOGY

By

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ABBREVIATIONS

RAU	:: Recurrent Aphthous Ulcer
RAS	:: Recurrent Aphthous Stomatitis
TLRs	:: Toll-Like Receptors
PAMP/MAMP	:: Pathogen- or- Microbial Associated Molecular Pattern
DAMP	:: Damage Associated Molecular Pattern
LASER	:: Light Amplification By Stimulated Emission Of Radiation
LLLT	:: Low Level Laser Therapy
RCTs	:: Randomized Clinical Trials
MiRAS	:: Minor Recurrent Aphthous Stomatitis
MaRAS	:: Major Recurrent Aphthous Stomatitis
HU	:: Herpetiform Ulcer
OSHC	:: Oral Health in School Children
MAGIC Syndrome	::Mouth And Genital ulcers with Inflamed Cartilage syndrome
PFAPA	:: Periodic Fever, Aphthosis, Pharyngitis, and Adenitis
HLA	:: Human Leukocyte Antigen
HSP	:: Heat Shock Protein
EBV	:: Epstein Barr Virus
HIV	:: Human Papilloma Virus
AIDS	:: Acquired Immune Deficiency Syndrome
SLS	:: Sodium Lauryl Sulphate
TNFα	:: Tumor Necroing Factor Alpha
EM	:: Erythema Multiforme
OLP	:: Oral Lichen Planus
VEGF	:: Vascular Endothelial Growth Factor
WHO	:: World Health Organization
CO_2	:: Carbon Dioxide
Nd:YAG	:: Neodymium: Yttrium Aluminium Garnet

KTP :: Potassium Titanyl Phosphate

Er:YAG :: Erbium: Yttrium Aluminium Garnet

LLLT :: Low Level Laser Therapy

MASER :: Microwave Amplification By Stimulated Emission Of Radiation

DH :: Dentinal Hypersensitivity

ANSI :: American National Standards Institute

OSHA :: Occupational Safety and Health Administration

VAS :: Visual Analogue Scale

YSGG :: Yttrium Scandium Gallium Garnet

HSP :: Heat Shock Protein

OCT :: Optical Coherence Tomography

PDT :: Photodynamic Therapy

KTP :: Potassium Titanyl Phosphate

H_2O_2 :: Hydrogen Peroxide

NaOCl :: Sodium Hypochlorite

CONSORT :: Consolidated Standards Of Reporting Trials Guideline

SPSS :: Statistical Package for Social Science

SD :: Standard Deviation

ANOVA :: Analysis of Variance

INTRODUCTION

Recurrent aphthous ulcer (RAU; aphthae) is a common, painful, chronic inflammatory disease affecting up to 25% of the population, with a slightly higher prevalence in women and in groups of a higher socioeconomic status. The most common type of RAU is minor RAU. It occurs on non- keratinized mucosa, the ulcers are round, well defined, painful surrounded by erythematous halo with necrotic center having diameter less than 1 cm.[1]

The etiopathogenesis of RAU remains unclear, but an abnormal immune interaction within the oral mucosal cells caused by the impaired activation of the immune system in genetically predisposed patients have been considered to be an important contributor in this process.[2]

In aphthous ulcers, the barrier function of the oral epithelium is destroyed. The exposure of danger-signal receptors, such as Toll-like receptors (TLRs), to pathogen- or microbial-associated (PAMP/MAMP) and damage-associated molecular patterns (DAMP) leads to an acute inflammatory reaction with cytokine production in the epithelial cells.[1,2] The possible modifiers of the immune system in Recurrent Aphthous Stomatitis includes various local as well as systemic factors, e.g., stress and anxiety, mineral and vitamin deficiencies, hematological disorders, viral and bacterial infections along with food allergies, trauma, smoking, or even left- or right-handedness. Systemic diseases and medications have also been suggested as the potential triggers of RAS in several studies, although the results remain equivocal.[3]

Different treatment modalities have been used to treat this condition which systemic medication, topical application, acupuncture, corticosteroids & LASER therapy.

Recently, it has been suggested that laser therapy could be successfully used as an efficient treatment approach in therapy of RAU. Therefore, the aim of this study is to

compare the treatment efficacy and pain relief of Low Level Laser Therapy & corticosteroid therapy in patient suffering from Recurrent Aphthous Ulcer.

LASER an acronym used for the Light Amplification by the Stimulated Emission of Radiation, it was discovered in 1960.[4] Low Level Laser Therapy (LLLT) is also known as 'soft tissue laser therapy' or bio-stimulation. Laser provides better inflammatory responses with oedema and pain reduction and cellular bio-stimulation, it forms an alternative to processes that present pain and inflammatory reactions, which requires tissue regeneration.

Low-level laser therapy (LLLT) involves the use of photons with non-thermal irradiance to alter biological activity. It is a non-invasive and atraumatic therapeutic method that involves the local application of a high density, monochromatic, narrow-band light source.[5] The main medical usage of LLLT is for pain and inflammation reduction with promoting the regeneration of different tissues and preventing damage to tissues. With the use of the power range (from 5 to 200 mW) and wavelength (630–680 nm, 700–830 nm or 900 nm), the therapy brings anti-inflammatory and analgesic results and wound healing is promoted.[4] The mechanism of action of LLLT may be very beneficial in the treatment of oral erosions and ulcers. There are few reports on accelerated healing in erosive mucocutaneous disorders and they are often presented as case series rather than large randomized clinical trials (RCTs). The effects on skin wound healing and periodontal inflammation management with laser bio stimulation suggest that this treatment modality may also be useful for oral erosive conditions.[6]

AIM & OBJECTIVES

AIM

To compare the treatment efficacy and pain relief of Low Level Laser Therapy & Triamcinolone Acetonide 0.1% therapy in patient suffering from Recurrent Aphthous Ulcer.

OBJETIVES

- To assess the efficacy of LLLT in patients with RAU.
- To assess the efficacy of Triamcinolone Acetonide 0.1% in patients with RAU.
- To compare the effects of LLLT and Triamcinolone Acetonide 0.1% among both groups.

REVIEW OF LITERATURE

RECURRENT APTHOUS STOMATITIS

Introduction

Aphthae (i.e., canker sores) have been plagued mankind throughout recorded history and were first mentioned by Hippocrates (460–370 BC) who utilized the term aphthai' to describe disorders of the mouth.[7] Recurrent aphthous stomatitis (RAS, aphthae, canker sores) is a common condition characterized by multiple recurrent small, round, or ovoid ulcers with circumscribed margins, erythematous haloes, yellow or grey floors typically presenting first in childhood or adolescence as per large USA-based studies, RAS is the most common inflammatory ulcerative condition of the oral cavity.[8] RAS is the most common ulcerative disease of oral mucosa which makes the diagnosis and management of these recurring oral lesions common problems in general and specialty dental practice.[9]

S.R.porter et al in (1998) reviewed and stated that RAS consist of recurrent bouts of one or several rounded, shallow, painful oral ulcers at intervals of a few months to a few days. RAS has 3 main presentations-minor (MiRAS), major (MaRAS), or herpetiform (HU) ulcers. Minor recurrent aphthous stomatitis (MiRAS) is characterized by round or oval shallow ulcers usually less than 5 mm in diameter, with a grey-white pseudo membrane enveloped by a thin erythematous halo. Major recurrent aphthous stomatitis also known as periadenitis mucosa necrotica recurrence is oval and may exceed 1 cm in diameter, they may approach 3 cm.[10] MaRAS has a predilection for the lips, soft palate, and fauces, but can affect any site. The ulcers of MARAS persist for up to 6 weeks and often heal with scarring. The third and last common variety of RAS is herpetiform (HU), characterized by multiple recurrent aphthous of small, painful ulcers that are widespread and may be distributed

throughout the oral cavity. There may be 100 ulcers present at a given time, each measuring 2-3 mm in diameter, although they tend to fuse, producing large irregular ulcers.[10]

Robert W. Rayons in (2001) reviewed and stated that "Aphthous" comes from the Greek word “aphtha," which means ulcer.[11] Aphthous ulcers are round or oval, with a greyish yellow in colour, crateriform base surrounded by an erythematous halo of inflamed mucosa.[6] 24-48 hours the appearance of an ulcer, most patients have a burning sensation in the affected area. The ulcer usually occurs on the non-keratinized oral mucosa, including buccal mucosa, the floor of the mouth, the soft palate, and the ventral surface of the tongue. Keratinized oral mucosa, are uncommon locations such as the hard palate, the gums, and the dorsal surface of the tongue.[12]

S.S.Natab et al in (2004) reviewed and stated that Recurrent aphthous ulcers occur in men and women of all ages, races and geographic regions and at least 1 in 5 individuals has been at least once afflicted with the aphthous ulcers.[13] It has been estimated that 20% of the general population will suffer from RAU at some time in their lives. In childhood, RAU is the most common form of oral ulceration. It seems to be more common in children and adults of higher rather than lower socio-economic status. The cumulative prevalence of RAU varies from 5 to 66% of the population, depending on the group studied. The peak age at onset is the second decade and thigh prevalence and severity of disease has been found in students of high socio-economic background.[13]

Epidemiology

RAS prevalence is higher (male, 48.3%; female, 57.2%) among professional-school students than in the same subjects 12 years later when they had become practicing professionals.[12] This finding led to some investigators to theorize that stress during student life is a major factor for RAS, although the difference in age groups should also be considered.[9]

Epidemiologic studies have shown that the prevalence of RAS is influenced by the population studied, diagnostic criteria, along with environmental factors. In children, the prevalence of RAS may be as high as 39% and is influenced by the presence of RAS in one or both parents.[14] Children with history of RAS-positive parents have a 90% chance of developing RAS compared with 20% in those with RAS-negative parents. The onset of RAS seems to peak between the people 10 and 19 years before becoming less frequent with advancing age.[14]

Predisposing etiologic factors

The aetiology of RAS lesions is unknown, several local, systemic, immunologic, genetic, allergic, nutritional, and microbial factors have been proposed as causative agents.[9]

The etiology of RAS is still poorly understood but **Sawair, in 2010**, mentions that factors such as stress, physical and/or chemical trauma, food sensitivity and genetic predisposition can favor recurrent episodes of the condition.[15] **Mahmoud *et al.(2012)***, in 2012, classified this disease as presenting a multifactorial etiology. Regarding genetic predisposition, it has been reported that around 40% of RAS patients have a family history, are likely to develop the condition earlier and more severely.[9]

Mahmoud et al. (2012) research investigated the psychological profile of 50 RAS patients, detected that either stress situations or anxiety can favour the recurrence episodes. The authors explain that in stressful situations the concentration of salivary cortisol increases as there is a subsequent stimulus of the immunological system for the recruitment of leukocytes to inflammation sites, plays essential role in the pathogenesis of the condition. As this study was a retrospective analysis, it was not possible to identify any associated psychological factor.[15]

ZuzaanaS lebioda et al in (2014) reviewed and stated that the potential trigger factors for etiopathogenesis of RAS include genetic predisposition, viral and bacterial infections, food allergies, vitamin and microelement deficiencies, systemic diseases (e.g., celiac disease, Crohn's disease, ulcerative colitis, AIDS), increases oxidative stress, hormonal defects mechanical injuries and anxiety in patients. Recently, also the atopic background of the condition has been suggested. In genetically predisposed patients, the effect of certain trigger factors initiates that the cascade of proinflammatory cytokines, directed against selected regions of the oral mucosa. The microscopic observation of the aphthous region reveals a massive leukocytic infiltration, that varies depending on the disease duration and severity. In the initial phase that precedes the ulcer formation, monocytes and lymphocytes (mainly of the T type) together with single mast and plasmatic cells accumulate under the basal cell layer. In more advanced stages, polynuclear leukocytes dominate in the centre of the ulcer, while on the lesion border the abundant mononuclear cell infiltration can be observed.[16]

Kleinman et al.(2015) reported that the prevalence of RAS was 1.23% while lifetime prevalence was 36.5% on the basis of above results of oral mucosal examinations on a

probability sample of 40 693 patients in USA school children performed as part of the National Survey of Oral Health in USA Schoolchildren, 1986–1987 (OHSC).[17]

Sawair(2016) found smoking had protective effect on mucosa of smokers for recurrence episodes of aphthous ulcers. In our study, it was not possible to verify this association since information regarding this was unavailable.[18]

The proposed etiologic factors associated with RAS are as follows:

TABLE 1 : Etiologic Factors Associated With RAS[9]

Local trauma	Smoking Dysregulated saliva composition
Microbial	Bacterial: Streptococci Viral: Varicella zoster, Cytomegalovirus
Systemic	Behcet's disease Mouth and genital ulcers with inflamed cartilage (MAGIC) syndrome Crohn's disease Ulcerative colitis HIV infection Periodic fever, aphthosis, pharyngitis, and adenitis (PFAPA) or Marshall's syndrome Cyclic neutropenia Stress, psychologic imbalance, menstrual cycle

Nutritional	Gluten-sensitive enteropathy Iron, folic acid, zinc deficiencies Vitamin B1, B2, B6, and B12 deficiencies
Genetic	Ethnicity HLA haplotypes
Allergic/immunologic	Local T-lymphocyte cytotoxicity Abnormal CD4:CD8 ratio Dysregulated cytokine levels Microbe-induced hypersensitivity Sodium lauryl sulfate sensitivity Food sensitivity
Other	Antioxidants Non-steroidal anti-inflammatory drugs Beta blocker

Local factors

Local trauma is regarded as causative agent for RAS in most susceptible individuals, and RAS are uncommon where mucosal keratinization is present or in patients who smoke tobacco. Trauma predisposes to RAS by inducing edema, early cellular inflammation associated with an increased viscosity of oral submucosal extracellular matrix in the patient. Not all oral trauma lead to RAS, as denture wearers are usually three times more susceptible to oral mucosal ulceration.[19]

There are some changes in salivary composition, like pH, that affect the local properties of saliva and a stress induced rise in salivary cortisol have been correlated with RAS. The various other salivary components also have been positively associated with RAS-like Tumour Necrosis Factor-alpha, Salivary nitric oxide and others.[20]

Microbial factors

A local microbial basis for RAS may explain why only oral mucosa is affected in patients with RAS. However, as there are no evidence of gathering of affected patients (other than via vague family associations), an infectious basis for RAS seems unlikely.

Both laymen and some clinicians confuses RAS with herpes simplex virus infection although many studies have demonstrated that RAS is not caused by herpes simplex virus.[21]

Several studies have carried out to find out the possible involvement of Streptococci species in etiology of RAS, especially *S. sanguis* 2A. Some studies have found that there is some cross reactivity between the streptococcal 65-kDa Heat Shock Protein (HSP) and the 60-kDa human mitochondrial HSP. It thus has been suggested there is a molecular basis for earlier work suggesting a link between RAS and Streptococcus *Sanguis,* due to monoclonal antibodies on part of the 65-kDa HSP of Mycobacterium Tuberculosis react *S. Sanguis*. Thus, RAS might be a T-cell-mediated response to antigens of *S. Sanguis* cross-react with the mitochondrial HSP and induce oral mucosal damage. This theory is still unproven.[22]

Helicobacter pylori has been proposed a causative role in RAS because it is a common risk factor for gastric and duodenal ulcers. Studies using molecular

techniques have demonstrated H. pylori in both patients affected and non-affected mucosa of RAS patients and found no association with RAS; thus, patients with stomach ulcer may not be unusually susceptible to RAS.

Now studies conducted by **Shimoyama et al. and Mravak-Stipetic M et al.** have shown that there is no raised in frequency of local carriage of H. pylori has detected in individuals with RAS.[23]

Epstein–Barr virus (EBV) and lactobacillus are other organisms are studied in RAS patients. A study of the possible role of lactobacillus in RAS has yielded no significant finding, but in a small study, EBV was associated with epithelial cells of pre-ulcerative RAS.[23]

Underlying medical disease

Several medical disorders are associated with those oral ulcerations that resemble RAS.

Behcet's syndrome

It is a multisystem disorder resulting from vasculitis of small and medium sized vessels and inflammation of epithelium. The abnormal inflammatory response in Behcet's syndrome is caused by the immune complexes which are induced by T lymphocytes and plasma cells. Behcet's syndrome normally affects adults, but a number of cases have been reported in children.[24]

Recurrent aphthous stomatitis-like ulceration is a primary feature of Behcet's disease. The ulceration might be more severe and more likely to comprise major or herpetiform ulcers from RAS. Patients with Behcet's disease also have recurrent genital ulceration, cutaneous disease (usually papulopustular lesions or erythema

nodosum), ocular disease (typically posterior uveitis), also a range of other gastrointestinal, neurological, renal, joint, and haematological abnormalities.[24]

MAGIC syndrome

It is another variant of Behcet's syndrome which includes relapsing polychondritis, it is a disorder characterized by mouth and genital ulcers with inflamed cartilage, has been labelled MAGIC syndrome.[25,26]

Sweet's syndrome

It is also known as acute neutrophilic dermatosis, and affected patients suffer with superficial ulceration similar to RAS. In addition, there is a sudden onset in fever, leucocytosis, and well-demarcated cutaneous, plum-colored papules or plaques. Sweet's syndrome usually arises in middle-aged females. In 50% of patients, there is an associated malignancy (e.g., acute myeloid leukemia).[24]

PFAPA syndrome

Patients have periodic fever, aphthae-like oral mucosal ulceration, pharyngitis, and cervical adenitis. PFAPA tends to occur in young children and tends to be self-limiting and non-recurrent.[24]

Cyclic neutropenia

It is a rare disorder that presents at childhood, is also associated with recurring oral ulcers during periods when the neutrophil count is depressed. There is cyclic reduction in circulation of neutrophils about every 21 days. Affected patients develops following oral ulceration, fever, cutaneous abscesses, upper respiratory tract

infections, and lymphadenopathy. Other oral complications may include severe gingivitis and aggressive periodontitis.[9]

HIV disease

Aphthous-like ulceration may occasionally arise in HIV patients. However, it remains unclear, if there is a significantly raised the frequency of recurrent idiopathic oral ulceration in HIV disease, RAS occurs more frequently, lasts longer, and causes more painful symptoms than healthy individuals and is a common finding in HIV-positive children. RAS is usually a late finding in AIDS patients with CD4+ lymphocyte counts below 100 cells⁄mm^3, but it may occasionally be a presenting sign of HIV infection.[27]

Crohn's disease

Aphthous-like ulceration can be a important feature of inflammatory bowel diseases like Crohn's disease and ulcerative colitis. This ulceration may reflect associated haematinic deficiencies while some researchers believe inflammation of minor salivary glands to be the cause of these oral ulcers. Approximately 10% of patients with Crohn's disease have oral mucosal ulcers, and the oral manifestations occasionally precede intestinal symptoms.[28]

Hereditary and genetic factors

At least 40% of RAS patients have familial history of RAS. The role of heredity is best-defined underlying cause of RAS.[29] Children with RAS-positive parents have 90% chance of developing RAS. Patients with positive family history of RAU, they tend to develop RAS at an early age. RAS lesions appear more frequently, demonstrate more severe symptoms.[30]

Certain genetically specific HLAs have been identified in RAU patients: HLA-A2, HLA-B5, HLA-B12, HLAB44, HLA-B51, HLA-B52, HLA-DR2, HLA-DR7, and HLA-DQ series. A confounding finding have certain ethnic groups have been associated with different HLA alleles or haplotypes, with no HLA consistently associated with RAS. More studies are needed to clarify the variability of RAS in host susceptibility.[31]

Allergic factors

Allergy have been suspected as a cause of RAS, and hypersensitivity to certain food substances, oral microbes such as *S. sanguis*, and microbial heat shock protein have been suggested as possible causative factors, although there is no strong evidence that allergy and/or hypersensitivity is a major cause of this disorder.[9]

Foods such as chocolate, coffee, peanuts, cereals, almonds, strawberries, cheese, tomatoes (even the skin of the tomatoes), wheat flour (containing gluten) may be implicated in some RAS patients. A possible link between food allergy and some cases of RAS have suggested as sequential elimination of dietary items such as milk, cheese, and wheat, has been found beneficial in a small subset of RAU patients presenting with refractory cases of RAS.[32]

The denaturing effect of sodium lauryl sulphate (SLS) is commonly found in toothpastes has also been discussed as a cause of RAS. It was proposed SLS might erode the oral mucin layer, exposing underlying epithelium, thereby making an individual more susceptible to RAS. This theory is questionable because of a more recent study demonstrated that use of SLS-free toothpastes did not affect development of new lesions in RAS patients.[9]

Immunologic factors

Over the past 30 years, the most of research on the cause of RAS focused on detecting an abnormality in the immunologic response. Earlier works suggested a relationship between several immune-mediated reactions and development of RAS. These reactions have included cytotoxicity of T lymphocytes to oral epithelium, antibody dependent cell-mediated cytotoxicity, and defects in lymphocyte subpopulations.[33]

One of the theories is that multiple immune reactions cause damage induced by deposition of immune complexes within the oral epithelium. More recent studies have shown an association between RAS severity and abnormal proportions of CD4+ & CD8+ cells, alteration of the CD4+:CD8+ ratio & elevated levels of interleukin 2, interferon gamma, and Tumour Necrosing Factor-alpha (TNFα) mRNA in RAS lesions. An immunohistochemical studies of RAS biopsy tissues has demonstrated numerous inflammatory cells with variable ratios of CD4+:CD8+ T lymphocytes depending on the ulcer's duration. CD4+ cells were more numerous during the pre-ulcerative and healing stages, whereas CD8+ cells tended to be more numerous during the ulcerative state of the ulcer. Similar study on non-affected sites were found negative, which made researchers focus more on the theory that RAS may be caused by an antigen-triggering effect. Because presence levels of serum immunoglobulins and natural killer cells are essentially within normal limits in RAS patients, the focus is still on a dys-regulated, local, cell-mediated immune response conducive to accumulation of subsets of T cells, mostly CD8+ cells. The local immune response causes an eventual tissue breakdown that manifests as RAS.[9]

Nutritional factors

The role of nutritional deficiency in causing of RAS, has been highlighted by the association of a small subset of 5% to 10% of RAS patients with low serum levels of iron, zinc, folate, or vitamins B1, B2, B6, and B12.[34]

Some of the above mentioned nutritional deficiencies may be secondary to other diseases such as malabsorption syndrome or gluten sensitivity associated with or without enteropathy. Hematologic screening of RAS patients for anaemia (deficiency of iron), foliate, and B vitamins is appropriate for patients with major RAS or cases of minor RAS (MiRAS) that worsen during adult life. A deficiency of vitamin C and Calcium has also been recently proposed in patients with RAS, but these findings were in coalition with vitamin B1 deficiency, supporting the idea of combined nutritional deficiency in RAS patients.[35]

Psychologic stress

Stress & psychological imbalance have been associated with RAS. In women, appearance of RAS may harmonize with menses. Stress of student life may be the precipitating factor for the higher preponderance of RAS in a cohort of professional students.[36]

Other factors

The role of antioxidants in RAS is currently attracting attention because blood levels of antioxidants such as erythrocyte catalase and superoxide dismutase seem to be higher in patients with RAS and Behcet's syndrome than in normal controls, but their causative roles in RAS are yet to be clearly defined.[9]

There have been several reported cases of drug-induced RAS. A recent case–control study associated with a higher risk of RAS, with drug exposure and found significant association with non-steroidal anti-inflammatory drugs and b-blockers. The medication history and current medications of RAS patients should be closely investigated to identify any pattern associated with the frequency and duration of RAS lesions.[9]

Clinical features

Recurrent Aphthous Stomatitis (RAS) comprises recurrent bouts of one or several rounded, shallow, painful ulcers at intervals between few months to a few days. All forms of RAS are painful recurrent ulcers. Patients often have prodromal symptoms of tingling or burning before the appearance of the lesions.[37]

First episode of RAS most frequently begins during the second decade of life and may be precipitated by minor trauma, menstruation, upper respiratory tract infection, or contact with certain foods. Lesions are confined to oral mucosa and starts with prodromal burning any time from 2hrs to 48hrs before an ulcer appears. During the initial period, a localized area of erythema develops. Within hours, a small white papule forms, ulcerates, & gradually enlarges over the next 48 hrs –72 hrs. Individual lesions are usually round, symmetric, & shallow (similar to viral ulcers), but no tissue tags are present, and this helps to distinguish RAS from disease with irregular ulcers such as EM, pemphigus, and pemphigoid.[8,9]

Recurrent aphthous stomatitis (RAS) has three main presentations:

- Minor (MiRAS)
- Major (MaRAS)
- Herpetiform (HU) ulcers

Minor RAS

It is the most common presentation affecting about 80% of patients with RAS: ulcers are round or oval usually < 5 mm in diameter with a grey–white pseudomembrane and an erythematous halo. MiRAS usually occur on the labial and buccal mucosa and floor of mouth, but are uncommon on the gingiva, palate, or dorsum of the tongue. The ulcers usually heals within 10–14 days without scarring.

Pensin *et al.(2012)* researched on 30 participants with a history of RAS, with a minimal frequency of 4 episodes year where they were provided treatment with a propolis ointment, a resinous compound produced by bees for protection of the hive, as a 5% Orabase ointment. The research demonstrated that the use of this ointment reduces the pain and healing time and promoted a longer disease-free interval in RAS patients.

Minor RAU (MiRAU) has a tendency to appear on the movable, lining, and non-keratinized mucosae, predominately buccal and lip mucosa, ventral tongue, soft palate, and in the vestibule.[9]

TABLE : 2 Clinical Features

Size	< 0.5 cm
Shape	Oval
Number	1–5
Location	non-keratinised mucosa
Treatment	Topical Corticosteroids, Tetracycline mouth rinse

Management

The diagnosis of RAS is invariably based upon the history and clinical findings. It is essential, however, to always consider a possible systemic cause, especially when adult patients' gets sudden development what appears to be RAS.[38]

The proper treatment of RAS depends on the frequency, size, and number of the ulcers. The best treatment will control ulcers for the longest period with minimal adverse side effects.[26] The treatment approach should be determined by disease severity (i.e. pain, burning sensation), the patient's medical history, the frequency of flare-ups, and the patient's ability to tolerate the medication.[38]

Patients, who experienced the occasional episodes of minor aphthous ulcers, experience significant relief with appropriate topical therapy. Symptoms occuring from occasional small lesions are often adequately controlled with use of a protective emollient such as: Zilactin (Zila Pharmaceuticals, Phoenix, Arizona) or Orabase (Bristol Myers Squib, Princeton, New Jersey), used either alone or mixture with a Topical Anesthetic (such as Benzocaine). Other topical agents that can minimize patient discomfort includes: diclofenac, a non-steroidal anti-inflammatory drug, or amlexanox paste, which has also been shown to decrease the healing time of minor aphthae.[39]

Meng *et al. in (2009)* conducted a study, where they investigated & compared efficacy results of amlexanox (anti-allergic and anti-inflammatory agent) per os, in the form of adhesive sheets and amlexanox tablets for the treatment of recurrent minor aphthous ulcers, in order to analyze the differences b/w both forms. The authors concluded that there were no significant differences in the efficacy between the two types of treatment.[40]

Irene Belenguer-Guallar et al in (2014) reviewed and stated that the management of RAS should be based on identification and control of the possible predisposing factors, excluding possible underlying systemic causes, and the use of a detailed clinical history along with complementary procedures such as lab. test, where required.[28] Only in case of continuous outbreaks and symptoms, drug treatment should be prescribed, with the initial application of local treatments in all the cases. A broad range of topical medications are available, including antiseptics(chlorhexidine), anti-inflammatory drugs (amlexanox), antibiotics (tetracyclines) and corticosteroids (triamcinolone acetonid). In patients with constant and aggressive outbreaks (major aphthae), pain is intense and tropical treatment is unable to afford symptoms relief and systematic therapy is indicated in the forms of Corticosteroids (Prednisone) or Thalidomide, among the other drugs.[41]

The most commonly used drugs in Immune-mediated oral mucosal diseases are the topical corticosteroids.[29] The aim of behind treatment is to eliminate the symptoms, thereby, allowing the patient to eat, speak & perform normal oral hygiene, since topical corticosteroids reduce or even suppress the pain and shorten the aphthae healing time. In patients with RAS, the indicated drugs are Triamcinolone Acetonide, Fluocinolone Acetonide or Clobetasol Propionate, in the order of lesser to greater potency, according to the severity of the lesions. These three drugs can be taken as a pomade in orabase when the lesions of localized nature, or in rinse format when the lesions diffuses or very numerous. Triamcinolone Acetonide is used at concentrations ranging from 0.05-0.5%, applied 3-10 times a day during 3-5mins.[41] It is particularly specified in patients with small and mild erosive lesions. Some researchers consider the most effective concentration to be 0.1%. In order for healing, it is advisable to apply the medication directly onto the lesions, in direct contact for as long as possible,

and taking care not to eat or drink during 20mins after application, or touch the treated zone. If the corticosteroid is administered as an oral rinse, should be used for the indicated period of time, without swallowing the product.[42] On the other hand, fluocinolone acetonide at a conc. of 0.025-0.05%, applied 5-10 times a day during 3-5 minutes, affords medium to high potency, and is widely used in patients with more aggressive lesions. Lastly, 0.025% clobetasol propionate is the most potential topical corticosteroid, and, therefore, reserved for moderate or severe disease presentations. To this context, it is regarded as an alternative prior to the prescription of systemic therapy.[43]

A review by **Belenguer–Guallar et al (2014)** compared pharmacological and non-pharmacological methods of managing recurrent aphthous stomatitis. The author states that, the treatment usually starts with topical medications like antiseptics, anti-inflammatory agents, analgesics, antibiotics, anesthetics, corticosteroids, and few natural substances.[44] If there are no changes in the signs and symptoms, then systemic therapy with antibiotics, corticosteroids, and immune modulators are preferred. However, systemic drugs produce side-effects, &, in some instances, the patients are forced to suspend the therapy.

Table 3 : Treatment modalities of RAS[9]

Local physical treatment	Surgical removal Debridement Laser ablation Low dense ultrasound Chemical cautery (e.g., silver nitrate sticks) Physical barriers (e.g., cyanoacrylate adhesives)
Antimicrobials	Chlorhexidine gluconate (mouth rinse) Triclosan (mouth rinse) Topical tetracyclines (e.g., aureomycin, chlortetracycline, tetracycline)
Topical corticosteroids	Hydrocortisone hemisuccinate (pellets) Triamcinolone acetonide (in adhesive paste) Flucinonide (cream) Betamethasone valerate (mouth rinse) Betamethasone-17-benzoate (mouth rinse) Betamethasone-17-valerate (mouth rinse) Flumethasone pivolate (spray) Beclomethasone dipropionate (spray) Clobetasol propionate (cream) Mometasone furoate (cream)
Topical analgesics	Benzydamine hydrochloride (spray or mouth rinse) Topical anesthetics (gel)
Other topical anti-inflammatory agents	Amlexanox Sodium cromoglycate (lozenges) Carbenoxolone sodium mouth rinse Azelastine Human alpha-2-interferon (cream) Ciclosporin (mouth rinse) Deglycyrrhizinated liquorice Topical 5-aminosalicylic acid Prostaglandin E2 (gel) Topical granulocyte-macrophage Colony-stimulating factor Aspirin mouth rinse Diclofenac in hyaluronan Sucralfate

LASER

The word "LASER" is an acronym (short form) for Light Amplification by Stimulated Emission of Radiation.[45]

Over the last decade, it has seen an explosion of research work in the application of LASER Technology to general dental practice.[46] Lasers are not, new to the field as some of the in vitro studies report back to 1960's but it was not until the early 1980's till the lasers saw their first use in the clinical practice. When used efficaciously and ethically lasers are exceptional modalities of treatment for certain clinical conditions that dentist or dental surgeons treat on daily basis.[46]

Laser in dentistry, by Miaman(in the 1960s), led to a continuous research work in the various applications of lasers in dental practice. There are two lasers i.e hard lasers, such as, carbon dioxide(CO_2) Neodymium Yttrium Aluminium Garnet (Nd: YAG), and Er:YAG, which offers both hard tissue and soft tissue applications, but have limitations due to high costs and a potential for thermal injury to tooth pulp, whereas, on the other hand are cold or soft lasers, based on the semiconductor diode devices, which are compact, low cost devices used predominantly for soft tissue applications, are broadly termed as low level laser therapy(LLLT) or "bio stimulation". On account of the ease, efficiency, specificity, comfort, and cost over the conventional modalities, lasers are indicated for a wide variety of procedures in dental practice.[47]

HISTORY

LASER was initially known as MASER (Microwave Amplification by Stimulated Emission of Radiation). Nobel Prize for the development of LASER was given to Townes, Basov and Prokhorov in 1964. Credit for the development of the theory of spontaneous and stimulated emission of radiation however, is generally given to

Einstein for his treatise 'zur quantum theorie der starling' which was initially published in 1963.[48]

In 1917, Albert Einstein laid the foundation for the invention of the LASER & its' predecessor, 'the Maser,' by theorizing that the Photoelectric Amplification could emit a single frequency, or stimulated emission. The term 'LASER' was first time introduced to the public in 1959, in an article by a Columbia University graduate student, Gordon Gould. Theodore Maiman, Hughes Research Laboratories in Malibu, CA, built the first functioning laser, by using a mixture of Helium (He) and Neon (Ne).[36] The first laser to be developed was ruby laser in 1960.[35] And surprisingly second one was in 1961, when a laser generated from crystals of Yttrium-aluminium-garnet treated with 1-3% neodymium (Nd:YAG) was developed. Argon LASER was invented in 1962, whereas the Ruby LASER became the first medical Laser to coagulate retinal lesions, used in 1963.[49] The first LASER experiment in dentistry was reported in a study about the effects of a pulsed ruby laser on human caries.[37] Ruby laser was not effective in dental fields because of its high thermal effects on hard dental tissues. Patel, in 1964, at Bell Laboratories developed the CO_2 LASER. Diode Lasers are being extensively used in the field of dentistry nowadays.

The first report of the LASER interaction to the vital human tooth appeared in 1965, when Leon Goldman applied two pulses of Ruby Lasers to the tooth of his brother, Bernard, who was a dentist. Then came CO_2 lasers, which were well absorbed by enamel.[48]

CLASSIFICATION

Lasers are used in dental practice and it can be classified by various methods: According to the lasting medium used, such as, gas laser and solid laser; according to

tissue applicability, hard tissue and soft tissue laser; according to the range of wavelength, and of course the risk associated with laser application.[50]

1. **Soft tissue lasers:** KTP, Diode, and Nd: YAG laser wavelengths have chromophores of the pigments in soft tissue and pathogens such as, gingivalis, porphyromonas, as well as inflammatory and vascular tissues. CO_2 lasers do easily interact with free water molecules in soft tissue, as well as vaporize the intracellular water of pathogens.
2. **Soft and hard tissue lasers:** Erbium lasers (Er, Cr: YSGG and Er: YAG) are sometimes called as all tissue instruments because of their excellent absorption in both appetite crystals as well their maximum absorption by water content of soft and hard tissue. However, these wavelengths have limited hemostatic ability because they are not absorbed by hemoglobin and have pulse durations.[50]

MECHANISM OF ACTION

LASER- TISSUE INTERACTIONS

The basics:

Laser light is used to effect - controlled and précised changes on the target tissues, through the transfer of electro-magnetic energy in clinical dentistry. Light energy connects with a target medium (e.g. Oral Tissues) in one of the four ways.

Transmission: Laser beam travels through the medium and emerges distally without any interaction with the medium. The beam exits either unchanged or partially reflected.[51]

This effect is dependent on the wavelength of LASER light. Water, for e.g., is relatively transparent to the diode & Nd: YAG wavelengths, whereas tissue fluids readily absorb Erbium and Carbon Dioxide at the outer surface, so there is very little energy transmitted to adjacent tissues. As another example, the diode and Nd:YAG lasers can be transmitted through the lens, iris, and cornea of the eye, and can be absorbed on the retina.

Reflection: When either the density of the medium or angle of incidence is less than the reflective angle, total reflection of the beam will occur. The incident angles and emergence angles of the laser beam will remain the same for true reflection or some may scatter if the medium interface is non-homogenous or rough in nature.

The reflected laser light could maintain its accumulation in a narrow beam, or become more diffuse. As mentioned previously, the laser beam will become more divergent as the distance from the handpiece increases. However, some laser beams can still have adequate energy at distances over 3 meters. In any event, this reflection can be very dangerous because the energy would be directed to an unintentional target or beside the targeted area, such as the eyes; and hence becomes major safety concern for laser operation.[51]

Scatter: There is an interaction between the laser beam and the medium, which is not intensive enough to cause complete attenuation of the beam. The scattered light decreases the laser energy with distance, together with a distortion in the beam (rays travel in an uncontrolled direction through the medium).

The scattered laser beam could cause heat transfer to the tissue adjacent to the surgical site, and result in unwanted severe damage. However, a beam deflected in different directions may be useful in facilitating the curing of composite resin.

Absorption: The incident energy of the laser beam is attenuated by the medium and convened into another form. With the use of dental diode lasers, the most common form of conversion of laser energy is into heat energy or, in the case of very low energy; bio modulation of receptor tissue sites seems to occur. Heat transfer mediated physical change in target tissue is termed photo thermolysis.[52]

The amount of laser energy that is absorbed by the tissue depends on the tissue characteristics, such as pigmentation and water content over, and on the laser wavelength and emission mode. The primary and beneficial goal of laser energy is absorption of the laser light by the intended biological tissue.[51]

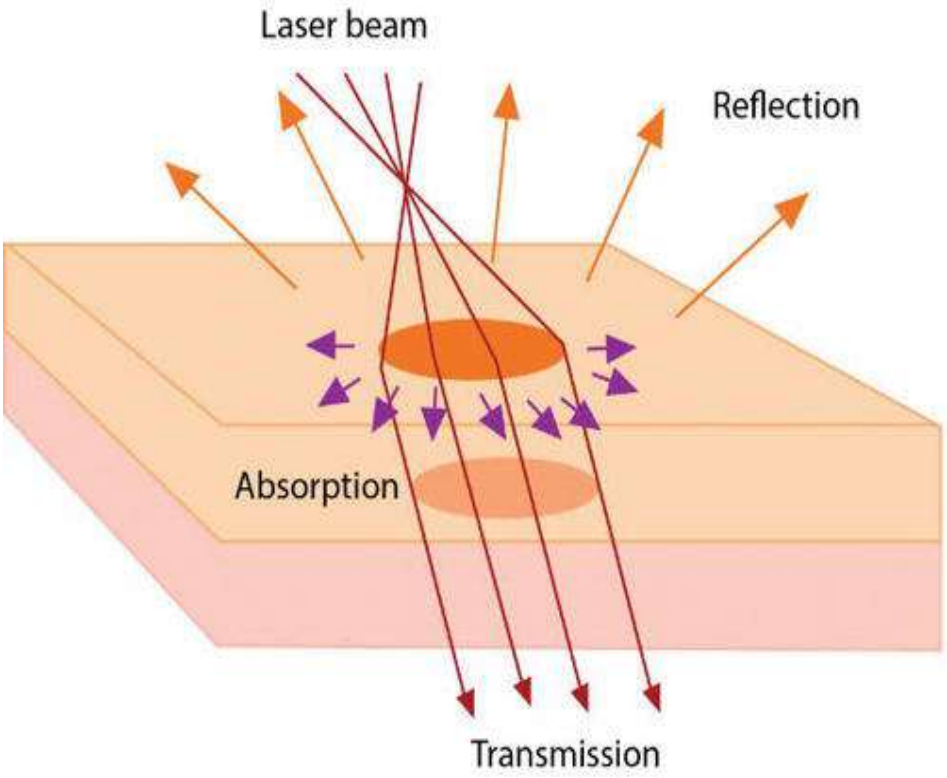


Figure 1: Possible laser light - tissue interactions

PHOTOBIOLOGICAL EFFECTS ON TISSUES

Each tissue has specific absorption characteristics based on it composition and chromophore content like as present in mammalian tissue are haemoglobin, melanin, water & protein. Infrared light is primarily absorbed by water, while visible & ultraviolet light are primarily absorbed by haemoglobin and melanin respectively. As the wavelength of ray decreases toward the violet and ultraviolet part of the spectrum, scattering or absorption from covalent bonds in protein limits penetration depth in this wavelength range. In order to target a specific tissue, the selected wavelength should be strongly absorbed by chromophores present in that tissue. Most medical laser applications depend on the absorption of laser light by target tissue and to heat the target tissue. To prevent this undesirable thermal injury to adjacent tissue, light can be applied in suitably timed pulses related to the size of the target structure according to the principle of selective photo thermolysis. The proper pulse width for targeting a structure will be in range as; larger structures will be best treated with a longer pulse and smaller structures by shorter pulses. Too long pulse may cause adjacent structures injuries and too short a pulse may cause insufficient energy to be delivered to the tissue in order to elicit a biologic effect on the target. Hence, it can be concluded that with proper selection of the wavelength, exposure time and intensity of the laser, the biologic effect on the target tissue can be optimized and undesirable collateral effects on adjacent tissues can be minimized or avoided.[52]

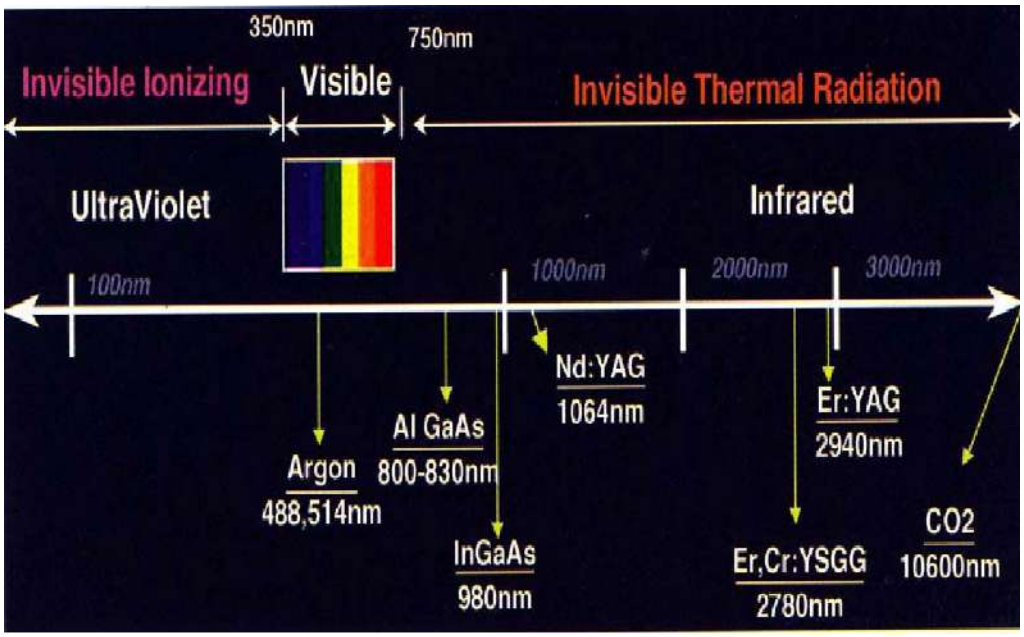


Figure 2: A portion of the electromagnetic spectrum showing dental laser wavelengths being used for treatment.

Below are the five interaction mechanisms associated with the use of lasers in biomedicine:

1. *Optical effect* i.e. used for fluorescence spectroscopy used for cancer screening, optical coherence tomography (OCT) for high-resolution imaging

2. *Photomechanical effect* (photoacustie) ie. used in laser lithotripsy, removal of tattoos and certain pigmented lesions

3. *Photochemical effect* i.e. used in photodynamic therapy (PDT), chemical reaction stimulation, composite resin polymerization.[51]

There are photochemical effects in the laser which can stimulate chemical reactions, such as the curing of composite resin; and break chemical bonds, such as using photosensitive compounds that, when

exposed to laser energy, can produce an singlet oxygen radical for disinfection of periodontal pockets and endodontic canals.

4. *Photothermal effect* i.e. used in laser resurfacing, treatment of vascular lesions, laser hair removal. It means the energy is transformed into heat. Surgical incisions and excisions with accompanying precision and hemostasis are one of the many results of a photothermal event when operated with correct parameters.[51,52]

5. *Photobiostimulative and photobiomodulative* effect i.e. low level laser therapy (LLLT), laser acupuncture, collagen remodelling for aged skin, anti-inflammatory treatments, blue light therapy for acne treatments, rapid wound healing, pain relief, increased collagen growth and a general anti- inflammatory effect.

Whether a laser system is suitable for incisions, vaporization, or coagulation, is mainly determined by the wavelength, the energy fluence, the optical characteristics of the tissues, and how the laser is operated. When operated in continuous mode, the laser provides a constant and stable delivery of energy. Lasers within the ultraviolet region (100 to 381nm) are able to ionize tissues, a process known as photochemical desorption. Lasers of longer wavelengths, especially those within the infrared part of the spectrum (700 to 10,000nm), cause significant tissue heating, as the light of these lasers is rapidly converted to thermal energy causing denaturation of proteins, decomposition of tissue, micro explosion of cell water and charring.[52]

Table 4: Benefits of laser tissue interaction

SOFT TISSUE	**HARD TISSUE**
Cut, coagulate, ablate or vaporize	Faster ablation
Dry surgical field	Reduced peri-operative cracking
Reduced post-operative edema	scope for minimally invasive restorative treatment of early caries
Sterilization of tissue	Reduced pulpal temperature rise
Decreased amount of scarring	Cavity sterilization

LASER ENERGY AND TISSUE TEMPERATURE

When a laser is absorbed by the tissue medium, it elevates the temperature and produces photochemical effects depending on the water content of the tissue. The first event which occurs is hyperthermia, when the temperature is elevated above normal but not destroyed. Non-sporulating bacteria are readily deactivated at a temperature of 50°C. Protein begins to denature at approximately 60°C and thus coagulation occurs (without vaporization of the underlying tissue). At 70 to 80°C, tissue welding or anastomosis occurs, that is, uniform heating will produce adherence of the layers because of stickiness due to the collagen molecules helical unfolding and intertwining with the adjacent segments.[53]

When a temperature of 100°C is reached, ablation occurs which is vaporization of the water within the tissue. Conversely, at temperatures above 200°C, an undesirable effect called carbonization occurs that is, the tissue is dehydrated and then burned.

Absorption of light requires its absorber, termed chromophores, which have a certain affinity for specific wavelengths of light. The primary chromophores in the intraoral soft tissue are, and Water, Melanin and Hemoglobin and in dental hard tissues are Water and Hydroxyapatite. Different laser wavelengths have different coefficient of absorption with respect to these primary tissue components, making the selection of laser procedure-dependent.[53]

LASER APPLICATION IN DENTISTRY

Table 5: Laser applications in dentistry[54]

Application	Possible laser types
Basic research Laser tissue interaction	All types
Oral medicine Laser doppler flow metre Laser induced fluorescence (caries diagnosis)	He Ne, diodes He Ne, diodes Diode
Photodynamic therapy (for treatment of oral cancer) To release fibrotic bands in OSMF Oral soft tissue lesions, frictional keratosis, leukoplakia, verrucous carcinoma)	ErCr:YSGG Diode
Conservative dentistry DH Cavity preparation Composite resin light curing Tooth surface conditioning, removal of defective composite restoration	CO2, Nd:YAG, Ee.YAG, Diode CO2, Nd:YAG, Er.YAG Argon, Er:YAG

Endodontics Root canal treatment, apicoectomy	Nd:YAG, CO2 CO2, Nd:YAG
Periodontics Laser-assisted curettage Gingivectomy and gingivoplasty	 Nd:YAG, diode CO_2
Analgesic effect and bio-stimulation Stimulation of wound healing	He Ne, diodes, Nd:YAG

DIODE LASER

Diode is a solid active medium laser, which are manufactured from semiconductor crystals using some combination of aluminium or indium, gallium, & arsenic. This chip material has the optical resonator mirrors which are directly attached to its ends, and an electrical current is used as the pumping mechanism. The available wavelength for dental use ranges from about 800 nm for the active medium containing aluminium, to 980 nm for the active medium Composed of indium, placing them at the beginning of the near infrared portion of the invisible non-ionizing spectrum. Each machine delivers laser energy fiber-optically in continuous wave and gated pulsed modes, and used in contact with soft tissue for Surgery or out of contact for deeper coagulation.[55]

Similar to an Argon Instrument, the optical fiber needs to be cleaved and prepared before initial use and also during the procedure to ensure the efficient operation. Few clinicians prefer to initiate the end of the fiber with a small amount of carbon pigment and do refer to this as a 'hot tip'. This method focuses a large amount of laser energy at the contact point and accelerates tissue incisions rapidly, but the operator must inspect the tip frequently to avoid it from being transformed into a ragged "branding iron" because of the rapid build-up of ablated products.[56]

All of the diode wavelength are highly absorbed by pigmented tissue and are deeply penetrating, although hemostatis is not as rapid as with the argon laser. These Lasers are relatively poorly absorbed by the tooth structure so that soft tissue surgery can be safely performed in close proximity to enable dentin and cementum. Also, similar to an Argon Instrument, the continuous wave emission diode of the diode laser can cause a rapid temperature rise in the target tissue. The clinician should use air and sometimes water to cool the surgical site on regular intervals and to continue to move the fiber around the treatment area. The diode is an excellent soft tissue surgical laser and is indicated for cutting and coagulating gingiva and mucosa and for sulcular debridement. The chief advantage of the diode lasers is one of a smaller size and portable instrument.

Other than surgical diode lasers, there are many other instruments used in dentistry. One manufacturer offers 4 visible red diodes with a wavelength of 655 nm and 1 milliwatt of Power (Diodent, Kavo, Lake Zurich, Ilinois). This red energy excites the fluorescence from carious tooth Structure, which is reflected back into a detector in the unit, which do analyzes and quantifies the degree of caries.[55]

Low-level laser therapy is provided by semiconductor instruments emitting visible and invisible near infrared light energy at powers significantly below any surgical threshold. They are called biostimulation.[44]

LASER DELIVERY SYSTEMS, EMISSION MODES

Laser energy should be delivered to the surgical site by various means that should be appropriate and precise. Shorter wavelength instruments, such as KTP, diode, Nd:YAG Lasers, have small, flexible fiber-optic systems with bare glass fibers that deliver the laser energy to the target tissue.[57]

The beam profile coming from a typical diode laser is rectangular, with a high divergence on the long axis (20 degrees from the Centre axis), and a low divergence on the short axis (2 degrees). This gives a highly divergent oval or "sweep' profile. Diode lasers may contain integrated optics which produces collimated and focused light beams. To obtain a more useful beam, a series of lenses or a Self-focusing graded index fiber can be used in front of the device to either deliver the treatment beam itself or to direct the laser output into a small diameter flexible optical fiber or a solid light guide (similar to the light tip on a curing light).

Contact mode is needed for all applications, when contacting dental Structures (enamel, dentin) some fluid might be needed to ensure full contact b/w the probe and surface to minimize loss of energy Whatever the delivery system used, it is important that the components which come into the direct contact with patients are able to be protected adequately with a laser transmissive disposable barrier, can be autoclaved, or are disposable. Similarly, it should be possible for the clinician to activate the laser

into treatment mode without breaching sepsis. Some units employ footswitches or light-operated switches to allow hands-free operation.[58]

Glasses are available which Provide Protection in both the visible and near infrared spectrum.

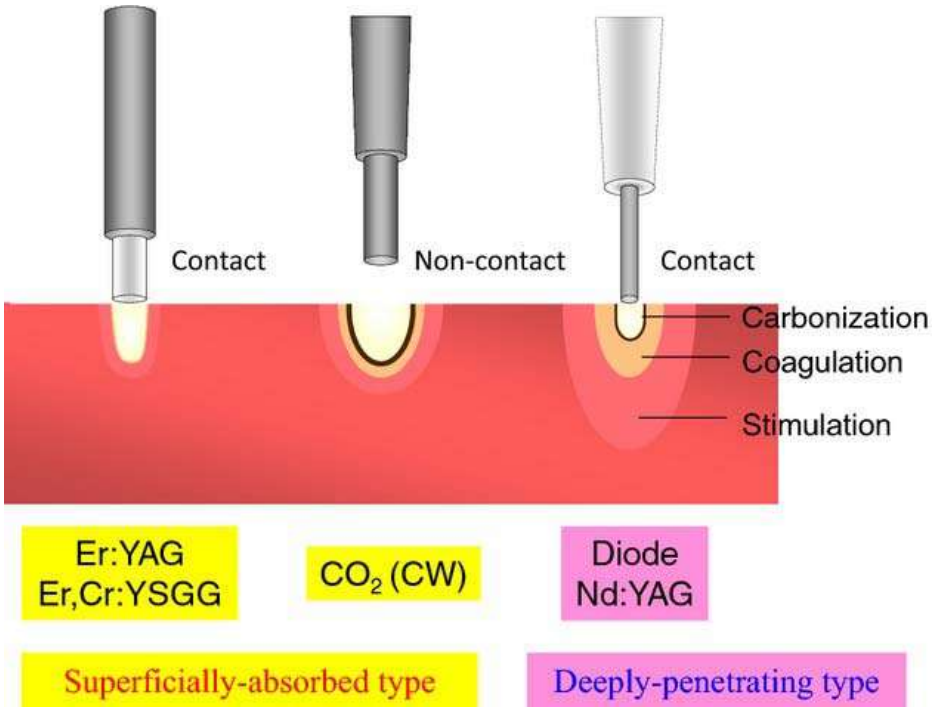


Figure 3: Modes Of application[57]

The focal point of the optical fiber is at or near the tip of the fiber, which again has the greatest energy. When the handpiece is moved away from the tissue and away from the focal point, the beam is defocused, and becomes more divergent, At a small divergent distance, the beam can cover a wider area, which helps in achieving hemostasis.[58] The spot size of the beam (relative to the target tissue) will determine the amount of laser energy (fluence — J/cm2) being delivered to an area. The spot size will increase with the increasing distance (optical fiber – target tissue).[57]

Continuous wave emission: It means that laser energy is emitted continuously – as long as laser is activated – and produces constant tissue interaction. CO2 and diode laser operate in this manner.

These laser are sometimes equipped with a mechanical shutter with a time Circuit or a digital mechanism to produce gated or super pulsed energy. Pulse duration can range from tenths of a second to several hundred microseconds.[58]

APPLICATION OF DIODE LASER

With the availability of portable and more cost-effective lasers, outpatient office-based laser treatment is evolving as the therapy of choice for OPLs like oral leukoplakia, or lichen planus. The standard (gold standard) for management of the clinically evident high-grade premalignant disease is excision or laser ablation. However, moderate and low-grade pre-malignancy, both can be treated with observation as well as an ablation.[59]

Fibromas

The soft tissue surgery can be performed by using the Laser. HF using the fibroma removal mode (975nm, 5W, CW).

Mucoceles

Mucoceles of the lip can be unroofed, and then excised with gland tissue using Laser HF, again using fibroma removal mode (975nm, 5W, CW). The wound margin may be sealed with a defocused beam. Re-epithelization takes about three weeks.

Palatel Lesions

Lesions of the Soft palate, such as traumatic fibromas in the soft palate, can be treated using Laser HF, fibroma removal Mode (975nm, 5W, CW).

Epulis fissuratum

Epulis fissuratum of the jaws can be removed using Laser HF, via a combination of Fibroma removal (975nm, 5W, CW) and Gingivectomy modes ((975nm, 3W, 10ms, 1:2), followed by LLLP application immediately after the surgical procedure.

Exposure of impacted teeth

Exposure of an Impacted tooth (soft tissue impaction) can be done using Laser HR, (Gingivectomy mode, 975nm, 3W, CW).

Dental implantology

Modification of the surgical laser technique can make it useful in Dental Implant-ology. The incisional mode of the diode laser can be used carefully to uncover implants as long as care is taken to prevent heat conduction from surrounding tissues does not conduct back into the implant; doing simply by limiting prolonged exposure.[55]

For detection of caries and sub gingival calculus

Diagnodent is caries detection tool, which is the diode laser with wavelength of 655nm. Laser fluorescence appears to compare favourably with standard methods of caries detection in occlusal fissure and the detection of sub gingival calculus. To access pulpal blood flow diodes of 633nm and 655nm are used.[49]

Loose Soft-Tissue Surgery

Applications include the removal of labial and lingual frenectomies, small hemangiomata, mucocele, denture granulomata, fibromata, treatment of nonerosive lichen planus, aphtha and herpes lesions,

"Fixed" Soft-Tissue Surgery

The diode laser (810nm) can be used for numerous "fixed" soft tissue procedures including gingival hyperplasia, tooth exposure and hyperpigmentation. Power settings of 1.5-3.0 watts with intervals should be optimal for most of the time, if not all gingival procedures.

Periodontal Therapy

The main use for the dental diode laser (810nm) in the periodontal therapy is the removal of diseased pocket lining epithelium and disinfection of periodontal pockets. Power setting of 0.8-1 W should be sufficient to ablate the epithelial lining. The treatment time per pocket should be around 20-30s, amounting possibly to 1-2 minutes per tooth site.[56]

Dental diode Laser in Endodontics

Effectiveness of the diode laser (810nm) is seen in root canal treatment (disinfection of the root canal), with slightly inferior bactericidal performance against Enterococcus faecalis when compared to a solid-state NIR Nd:YAG laser system. The antibacterial effect observed, do reaches over 1 mm deep into the dentin, after surpassing the effective range of chemical disinfectants, such as NaOCl and displaying moderate effectiveness against Enterococcus faecalis even in the deeper layers of dentin.

The Power should be set in the range of 1-1,5 W. Apart from decontamination efficacy, laser therapy has shown great promise the removal of the smear layer and debris that remains on root canal walls after mechanical instrumentation.[52]

Photothermal bleaching or tooth whitening

Diodes of 810-980 nm are used. The power setting for photothermal bleaching should be in the prescribed safety limits of 2W to prevent thermal effects on pulp. At the same, the power setting should be high enough to activate hydrogen peroxide (H_2O_2) in bleaching agent to breakdown into free radicals. These free radicals penetrate the tooth structure (enamel) and oxidates the stained molecules within the tooth structure.[59]

Low level laser therapy (LLLT)

LLLT is the ability of the lasers to non-thermally and non-destructively change the cell function. Diodes are the only lasers which are used for LLLT in the medical field. Low Lavel Laser Therapy (LLLT) has claimed significant neuro pharmacologic effects on the synthesis, release and metabolism of neurochemicals in the cells including serotonin, acetylcholine, histamine and prostaglandins. LLLT has illustrated a significant increase in the fibroblast production and collagen synthesis. These significant effects on cell exhibits wide range of benefits on biological tissue and altered pain threshold. LLLT also known as 'Biostimutlation' or 'Soft laser Therapy'. Other soft tissue procedures recommended using, diodes are Hypertrophic lesion surgery, operculectomy procedures, gingival contouring, and periodontal surgeries.[60]

ADVANTAGES OF DIODE LASER

1. Reduces the amount of bacteria and other pathogens in the operating field thus creating a sterilised field of operation.[50]

2. Reduces post-operative edema (through the sealing of small lymphatic vessels) and decrease the amount of scarring, contributing to faster and more effective treatment.[58]

3. lasers achieve excellent hemostasis, with the reduced need for sutures and surgical packing and thus enabling dry-field surgery.[50,51]

4. Healing of the laser incision blends well with surrounding structures compared to scalpel incision.

5. There is improved visualization of the surgical field after good control of bleeding which leads t0 better healing and less chances of infection.

6. Lasers can successfully and safely be used on wide range of the population such as children and pregnant women and old age persons.

7. Reduces anxiety or fear of surgical procedures.[51]

DISADVANTAGES OF DIODE LASER

1. They are relatively high cost and require training of the operator along with continuous education.[51]

2. A modification of clinical technique will be required as majority of dental instruments are both side- and end-cutting.

3. Accessibility to the surgical area can sometimes be a problem as the clinician must take precautions to prevent the overheating of the tissue and guard against the possibility of air embolisms produced by excessive pressure of the air and water spray used during the procedure.

4. Specific wavelength is needed for different procedures, so no single wavelength will optimally treat all dental disease.[56]

5. Lasers are hazardous to human eye sight.[51]

LASER SAFETY

1. General safety precautions and requirements include a laser warning symbol outside the clinic.

2. Eye protection for the operator, patient and the staff to protect against reflected laser light or accidental direct exposure. [Lasers when reflected on eyes can be focused by the eye into an extremely small spot on the retina, resulting in localized burning and permanent damage in seconds or even less time. So highly reflective instruments or instruments with mirrored surfaces should be avoided as to prevent reflection of the laser beam].

3. Adequate precautions needed to be taken to prevent injury or damage to adjacent soft and hard tissues or to the pulp or periodontal apparatus.

4. Equipment is serviced and checked regularly for proper and safe functioning.[51]

Lasers according to safety standards are broadly divided into four basic types by ANSI (American National Standards Institute) and OSHA (Occupational Safety and Health Administration) namely.[61]

Table 5 : Types of Lasers[9]

Class	Description
I	Low-powered lasers that are safe to use.
IIa	Low powered visible laser that are hazardous only when viewed directly for longer than 1000 seconds (15 min approximately).
IIb	Low-powered visible lasers that are hazardous only when viewed directly for longer than 0.25 seconds.
IIIa	Medium-powered lasers that are normally not hazardous if viewed for less than 0.25 seconds without magnifying optics
IIIb	Medium-powered lasers that can be hazardous if viewed directly
IV	High powered lasers (>0.25W) that produce ocular, skin and fire hazards.

MANAGEMENT OF ORAL RECURRENT APTHOUS ULCERS AND LASERS

Low-Level Laser Therapy (LLLT); is non-destructive amount of energy that occurs at the periphery of the target tissue simultaneously along high-level laser irradiation ("simultaneous LLLT"), or as independent ("pure LLLT") amount of power & energy density below the destructive level. It has bioactivating effects, such as increase of cell metabolism and/or tissue regeneration, thereby accelerating healing of the tissue, anti-inflammatory effects on the targeting tissues and cells, as well as reduction of pain of various etiologies. It has been recently confirmed report that LLLT can be successfully used as an advanced treatment modality in therapy of RAS.[53]

There are many studies compares the effect of lasers and topical corticosteroids in recurrent apthous ulcers, some of them are:

Prasad S, Pai A (2013) compared immediate pain relief, healing time between minor aphthous ulcers treated with a single session of carbon dioxide (CO_2) laser & a placebo. They performed study on 25 patients with minor aphthous stomatitis & pretreatment levels were recorded using a numerical rating scale. They concluded that CO_2 laser therapy in recurrent aphthous stomatitis (RAS) provides immediate pain relief sustained over 24hrs, along with accelerated healing time.[61]

Misra N, Maiti D, Misra P, Singh AK (2013) reported a case report on a 25year-old patient with 2 ulcers in his mouth. They advised a complete haemogram to rule out any systemic disease and laser therapy was given for immediate pain relief. They concluded that the laser therapy decreases the burning sensation immediately.[62]

Anand V. et al (2013) reported a case report on Low level laser therapy in the treatment of aphthous ulcer Two patients with the chief complaint of recurrent painful ulcers in the oral cavity came to the Department and laser therapy was given they concluded LLLT employed as a treatment modality for the management of minor recurrent aphthous ulcers in the current case report, not only provided instant pain relief by rapid decrease in the size of the lesion, but also no recurrence was seen even after 1 year of follow-up. Since, there is no medications were required, and their side effects and risk of overdosage could also be prevented. Hence, it can be concluded that LLLT is a safe and clinically effective therapy for treating minor RAS, along with time and cost benefit to the patients.[63]

Lalabonova H &Daskalov H (2014) conducted a study to clinically

assess the therapeutic effect of low-level laser therapy (LLLT) on chronic recurrent aphthous stomatitis (RAS) using a protocol they developed especially for the study. 180 patients were included & divided into group 1 (the study group) – 90 patients received LLLT & group 2 (controls) – 90 patients who received pharmacotherapy (Granofurin and solcoseryl given twice daily). They assessed that pain was completely managed in 55.6% of group 1 patients one day after therapy, while it took three days to alleviate pain for 11.1% of the patients in group 2. The Erythema was managed entirely in 24.4% of group 1 patients after the first session, no changes were found in any of the group 2 patients. Pain intensity had similar dynamics for both groups. In only 5 days, 75.6% of group 1 patients showed complete epithelization, while in group 2 the process was completed in only 37.8% of patients. The results they obtained using LLLT to treat chronic RAS were better than those obtained in the group receiving pharmacotherapy.[64]

Aggrawal H, Singh MP, Nahar P, Mathur H, Gv S (2014) conducted a study to assess the efficacy of Low-level laser therapy (LLLT) on recurrent aphthous ulcers for reduction of pain, lesion size, and healing time clinically and compared the results with a sham control group. Study was conducted on 30 patients with two separate aphthous ulcers. Each lesion was randomly allotted to either the active treatment group or the sham control group. They concluded that LLLT was effective in relieving pain and reducing the healing time during the treatment of aphthous ulcers.[65]

Guallar B I et al (2014) conducted a study in which a literature search was made of the PubMed, Cochrane and Scopus databases, limited to articles published between 2008-2012, with scientific levels of evidence 1&2 (metaanalyses, systematic reviews, phase I and II randomized clinical trials, cohort studies and case-control studies), and conducted in humans. The obtained results indicated that the management of RAS should be based on identification and control of the possible predisposing factors, with the exclusion of possible underlying systemic causes, and the use of a detailed clinical history along with complementary procedures such as lab. test, where ever required.[66]

Vale F. A. et al (2014) done a systematic review on Low-Level Laser Therapy in the Treatment of Recurrent Aphthous Ulcers in which systematic literature review identified 22 publications, of which only 2 studies were adopted. The eligibility criteria comprised of randomized controlled trials (RCTs). Despite the variance in irradiation conditions applied in both studies, very similar wavelengths were adopted and both RCTs achieved significant results concerning LLLT and pain-level reductions and reduced healing times. Taking into account the different parameters applied by selected RCTs, it is not possible to suggest that which specific protocol should be used.[67]

The review concluded LLLT can be suggested as an alternative for RAU treatment. Additional RCTs should be performed in order to reach a clinical protocol and to better understand the application of LLLT in RAU treatment.[67]

Babu B, Uppada U. K. et al (2015) reported a case report on Versatility of diode lasers in low-level laser therapy for the management of recurrent aphthous stomatitis. They concluded that LLLT gains an edge over the other existing treatment modalities due to its localized effects resulting in no harm to the adjacent tissues and no systemic toxicity. It is non-invasive with good patient compliance having no mutagenic effects and can repeatedly be used without risk. However, long-term comparative studies are needed to further substantiate and explain the advantages of LLLT in the treatment of oral lesions.[68]

Pavlic V., Aleksic V. V., et al (2015) reviewed the estimate the effects of laser therapy in treatment of RAS analyzing results of clinical studies published in peer reviewed journal in which they initially yielded a total of 228 publications. On the basis of title and abstract evaluation, authors agreed by discussion to exclude 204 publications. Remaining 24 publications in full-text format (relevant or possibly relevant) were retrieved for more detailed analys.[69]

Dr. Hasan S., Dr. Rai A. (2015) conducted a review on lasers in management of recurrent aphthous stomatitis- review of literature. They concluded Lasers have emerged as an alternative treatment modality for variety of soft tissue lesions, most commonly being RAS. It has bioactivating effects, such as increase of cell metabolism and/or tissue regeneration, which enhances would healing. Additionally, it has analgesic and anti-inflammatory effects on the targeted tissues.[70]

Jijin MJ, Rakaraddi M, Pai J, Jaishankar HP, Krupashankar R, Kavitha AP et al (2016) compared the treatment effects of 5% amlexanox and low level laser therapy (LLLT) ina cohort of patients who experienced minor aphthous stomatitis was performed on 50 participants having minor aphthous ulcers & divided into 2 groups. Group A were treated with amlexanox oral paste & group B with LLLT. They concluded that both amlexanox& LLLT were equally effective in relieving pain associated with minor aphthous stomatitis.[71]

Min Han, Hui Fang et al (2016) reviewed Effectiveness of Laser Therapy in the Management of Recurrent Aphthous Stomatitis: A Systematic Review in College & Hospital of Stomatology, Key Lab of Oral Diseases Research of Anhui Province, Anhui Medical University, Hefei 230032, China in which Five electronic databases were searched (MEDLINE (PubMed), EMBASE, ScienceDirect, the Cochrane Library, and Web of Science) to find all studies that were about randomized controlled clinical trials, involving the effect of laser therapy in RAS patients. They concluded Twenty-three studies were retained for full-text analysis after screening the titles and abstracts of potential articles, but only 10 studies satisfied the inclusion criteria after the full texts were reviewed. The all 10 included studies reported a comparison of the effectiveness between the laser treatment and placebo laser therapy (or conventional drug therapy) when managing the RAS patients. It can be concluded that laser therapy has the superiority in relieving ulcer pain and with shorter healing time when compared with placebo group or medical treatment group. Although laser therapy is a promising and effective treatment for RAS, high-quality clinical studies with large sample size must be further performed to confirm the effectiveness of this therapy.[72]

Najeeb S, Khurshid Z et al (2016) conducted a study in which a total of 85 articles were found during the initial search, 76 studies were excluded for not fulfilling the criteria, whereas, nine studies were found suitable for this review. Among 09 studies, 02 articles were case reports and 07 were randomized clinical trials. Study design, sample size, type of intervention and control of each study were critically analysed and summarized according to the CONSORT protocol. In most of the patients, immediate pain relief and accelerated ulcer healing was observed following irradiation with lasers. They concluded that although various types of lasers have succeeded in providing immediate pain relief to patients, carbon dioxide (CO2) lasers have the unique advantage of requiring a short.[73]

Kaur A, Misra N, Umapathy D (2017) reported a case report on 2 patients with different soft tissue lesions, soft tissue diode laser was used for excision & wound healing & assessed by visual method with the help of photographs. No discomfort was observed during and after procedure. They concluded that the laser treatments could be superior to conventional approaches with regards to easy ablation, decontamination & hemostasis & were less painful during and after procedure.[74]

Soliman HA, Mostafaa (2019) estimated the pain-relieving and healing properties of low energy level laser therapy using diode laser 660 nm on MiRAS. 20 healthy patients were randomly selected from the Out-Patient Clinic of Oral Medicine Department& divided into 2 groups study group who received 660nm diode laser irradiation while the control group received placebo (sodium bicarbonate rinse). The visual analogue scale, effectiveness indices, size reduction, and functional disorders were compared between the groups. They concluded that diode laser 660 nm should be further considered as an effective alternative therapeutic regimen to patients who suffer from recurrent aphthous stomatitis.[75]

Olejnik M et al (2019) reported a case report Low-level laser therapy (LLLT) in the treatment of recurrent aphthous stomatitis (RAS) – a promising treatment option in which 2 adult patients were given laser therapy they concluded that Low-level laser therapy may be considered an effective and non-invasive method of reducing symptoms and promoting the healing of aphthous ulcers in patients with RAS without addressing the cause. There is, still an urgent need to develop an effective, causative treatment for RAS.[76]

Mohammed K. A , Mohammed J.(2019) conducted a study compares low-level laser therapy with topical medications for treating aphthous ulcers in which systematic review was completed in six databases. Treatment and comparative groups were comprised of patients subjected to laser therapy and topical medications respectively. Two different treatment outcomes were considered as; pain and size of the lesion. Risk of bias was assessed by using the Revised Cochrane risk-of-bias tool for randomized trials. They concluded Low-level laser therapy was better in treating aphthous ulcer lesions in comparison to topical medications, and all laser wavelengths in the included reports were seen to be effective. However, the results needed to be interpreted with caution, because no study demonstrated low-risk of bias in all the assessed domains.[77]

Hussein H. et al (2021) conducted a study on Low-Level Diode Laser Therapy (LLLT) versus Topical Corticosteroids in the Management of Recurrent Aphthous Stomatitis Patients: A Randomized Controlled Trial to evaluate the effect of low-level laser therapy (LLLT) on recurrent aphthous stomatitis for reduction of pain score and ulcer size in which 28 participants with symptomatic minor recurrent aphthous ulcers were randomly allocated into two groups. The treatment group were provided a 980 nm diode laser and the control group received topical triamcinolone acetonide 0.1%.

The measured outcomes included pain score as visual analog scale (VAS) at baseline, second day, and seventh day, and the lesion size at baseline and seventh day. They concluded LLLT can be considered a reliable alternative to topical steroids in the management of recurrent aphthous ulcers since it was more effective in reducing both pain intensity and ulcer size.[78]

Pasquale C et al (2021) conducted a study on 808-Nm Near-Infrared Laser Photo biomodulation versus Switched-Off Laser Placebo in Major Aphthae Management: A Randomized Double-Blind Controlled Trial was conducted, in which a randomized, double-blind, controlled trial was conducted according to the CONSORT guideline. The Irradiation was performed through an 808-nm diode laser with flat-top handpiece, and 1 W, 1 W/cm2, 60 J, 60 J/cm2 for 60 s on a spot-size area of 1 cm2. Time of complete healing and pain evaluation by VAS scale were assessed.

Patients of the photo biomodulation group experienced complete healing in an average time of 8.13 days ± 1.69 (min 5–max 10 days), while for the placebo group, the average time extended to 30.76 ± 4.63 days (min 25 to max 42 days). Patients of the photo biomodulation therapy group experienced a statistically significant reduction in pain and discomfort 24 and 48 h after treatment ($p < 0.05$); the reduction was statistically on higher side ($p<0.05$) 48h after treatment compared to 24 h after. They concluded photo biomodulation at the parameters and modality of irradiation proposed accelerates the healing recovery and reduces pain compared to the patients treated with the placebo.[79]

TRIAMCINOLONE ACETONIDE

Glucocorticoids were first introduced in 1940s and they have become a widely prescribed class of drugs. Glucocorticoids including triamcinolone acetonide have potent anti-inflammatory actions, including the reduction in the number and function of various immune cells, such as T and B lymphocytes, monocytes, neutrophils, and eosinophils, at sites of inflammation. Glucocorticoids decrease production of cytokines, chemokines, and eicosanoids it enhances the production of macrophage migration inhibitory factor.[80]

Topically, Corticosteroid preparations containing hydrocortisone hemi succinate or triamcinolone acetonide to control symptoms are effective in reducing inflammation 10 and treating severe aphthous ulcers. Triamcinolone acetonide 0.1% is used as topical application 2 to 3 times a day for the treatment.[81]

Miles DA et al in (1993) conducted a study to compare the efficacy of Triamcinolone acetonide versus chlorhexidine for treatment of recurrent stomatitis. Thirty patients with recurrent aphthous stomatitis were selected from records of the Diagnostic Referral Clinic at Indiana University School of Dentistry and randomly divided into three groups; one group was a control. Experimental groups received a topical application of either triamcinolone acetonide (0.025%) or Chlorhexidine Di gluconate (0.12%). Medications were covered by isobutyl cyanoacrylate (Iso-Dent). Controls received the Iso-Dent only. A highly significant difference was present in pain intensity and perception was found at different days ($p < 0.0001$). No significant difference was found between triamcinolone acetonide and chlorhexidine gluconate ($p < 0.49$).[82]

Swarna YM et al in (2011) conducted a randomized, comparative study on efficacy of Tacrolimus and Triamcinolone acetonide in the management of symptomatic oral lichen planus. The study included 30 symptomatic OLP subjects divided into two as group A and group B to receive topical tacrolimus 0.03% ointment and triamcinolone acetonide 0.01% ointment application respectively, twice daily for four consecutive weeks. Topical corticosteroids effectively penetrate the squamous epithelium and have less severe side effects than systemic corticosteroids due to their low systemic absorption. The efficacy of triamcinolone acetonide ointment is due to local anti-inflammatory properties of suppressing T-cell function. This ointment has been proven to adhere well to the oral mucosa.[83] This can provide both transport medium of the active drugs and reasonable exposure time.

R.M. Browne et al (2011) conducted a double-blind clinical trial on topical Triamcinolone acetonide in treatment of the recurrent aphthous stomatitis. The results suggested that this preparation should be use in the treatment of severe episodes of recurrent aphthous stomatitis and not for long-term management of these patients.[84]

Topical corticosteroid can be effective drugs in the treatment RAS. Patient responses were variable, there are some individuals who gain little or no relief from their use.[85]

MM Fani et al in (2012) stated that Triamcinolone acetonide is a fluoride synthetic corticosteroid. Its cream (0.1%) and ointment (0.1%) forms are also available for topical use. The absorption rate varies from parts of body like 1% in palms and knee to 36% in face, eyelash and genital area. Its absorption increases via damaged, inflamed or dressed skin. Triamcinolone acetonide has anti-inflammatory properties and therefore could help to limit the full extent to which aphthous ulceration would progress. The small amount which may enter the systemic circulation is metabolized

in liver.[86] Topical application's side effects are as burning, itching, irritation, dryness, folliculitis, hirsutism hyperpigmentation, perioral dermatitis, contact allergic dermatitis, secondary infections and atrophy.

Valentina Sarao el al in (2012) stated that Triamcinolone acetonide has an anti-minatory potency five times higher than hydrocortisone with a 10th of the sodium-retaining potency. TA has shown to inhibit the inflammatory response, thereby reducing the oedema formation, leukocyte migration, capillary dilatation and fibroblast proliferation. Steroids acts by the induction of proteins called lipocortins, in particular phospholipase A2. These proteins reduce leukocyte chemotaxis, control biosynthesis, inhibit the release of arachidonic acid from the phospholipid membrane which is one of the most important precursors of potent inflammatory cell mediators such as prostaglandins and leukotrienes. The anti-inflammatory, angiostatic and anti-permeability proprieties of corticosteroids seem also to be related to the regulation of gene expression components. This regulation influences expression of vascular endothelial growth factor (VEGF), inhibits- pro-inflammatory genes such as tumor necrosis factor-alpha (TNF-α) and other inflammatory chemokines, also induces the expression of anti-inflammatory factors such as pigment epithelium-derived factor (PEDF).[87]

Hamed Hamishehkar et al in (2015) stated that Triamcinolone Acetonide, a medium to high potential corticosteroid, is a fluorinated prednisolone derivative and considered an intermediate-acting glucocorticoid. It is effective in the treatment of many disease-like dermatoses, asthma and allergic rhinitis and is used in the decreasing of the signs and symptoms of many oral inflammatory conditions, including RAS. Triamcinolone Acetonide dental paste was used for the adjunctive treatment and temporary relief of symptoms associated with oral inflammation and

gingival disorders. For effective therapy in conditions of the oral mucosa, the concentration of corticosteroid in the buccal mucosa should be preserved with minimal systematic absorption which could be achieved by incorporation of drugs in special dosage forms, it results in enhanced mucosal concentrations of drugs with reduced systemic absorption.[88]

MATERIALS & METHOD

AIM: To compare the treatment efficacy and pain relief of Low Level Laser Therapy & Triamcinolone Acetonide 0.1% therapy in patient suffering from Recurrent Aphthous Ulcer.

Place of study: Department of Oral Medicine and Radiology of Babu Banarasi Das College of Dental Sciences, Lucknow

Study subjects: For the study purpose 30 subjects who were diagnosed with RAS on the basis of the presence of well-defined grayish-white ulcer(s) on unkeratinized surfaces surrounded by a red halo. Subjects were asked about clinical history and duration including the presence of pain and burning sensation.[89] Subjects were asked about clinical history and duration including the presence of pain which was divided into 2 groups. Group A consist of 15 subjects on which Low Level Laser Therapy was used & Group B consist of 15 subjects on which Triamcinolone Acetonide 0.1% was advised.

Sample Size: - 30 patients

Material and Equipments used in the study with specifications and Company

A 980 nm diode LASER, 300micron thickness fibre ,1 watt, 3 min, low level laser therapy was used.

ARMAMENTARIUM

1. Dental chair with illuminating facility.

2. A pair of sterile disposable gloves and mouth mask.

3. Stainless steel kidney tray, mouth mirror, straight probe, tweezers and explorer.

4. Sterile gauze piece and cotton swab.

7. Laser Protection Glasses

8. The Diode Laser (LITE MEDICS)

a. Wavelength = 980nm

b. W=1-2.4 W

c. Power Supply input = 100-240 AC 50/60Hz

d. Pulse length = 1µs ÷ continuous

e. Pulse features = Super Short Pulse

f. Frequency = continuous ÷ 251KHz

g. Dimensions = 250x230x100mm LxPxH

h. Net weight = 2.5Kg

i. Medical class = 2B

j. Laser class = 4

Eligibility Criteria:

- **Inclusion criteria**:-
- Patient well oriented to time, place & person.
- Males and Females included between 18- 50 years.
- Patients with history of RAU in oral cavity with at least 3 episodes per year with no sign of any systemic disease related to RAU.
- Patient who had history of single / multiple, minor painful & RAU.
- Self reported patients with an acute episode of ulceration that lasted for 3 or more days.

Exclusion Criteria:-

- Patient with any systemic disorder.
- Patient having any other mucosal lesion/ ulcers other than minor RAU.
- Pregnant & lactating women.

Sampling Method

It was a randomized clinical trial in which the participants fulfilling the above criteria were randomly allotted into 2 groups.

Methodology:

In the study, all the subjects fulfilling the above criteria were enrolled for accessing treatment effects of Low Level Laser Therapy (LLLT) and Triamcinolone Acetonide 0.1% in RAU.

The study subjects were randomly selected & were divided into 2 groups.

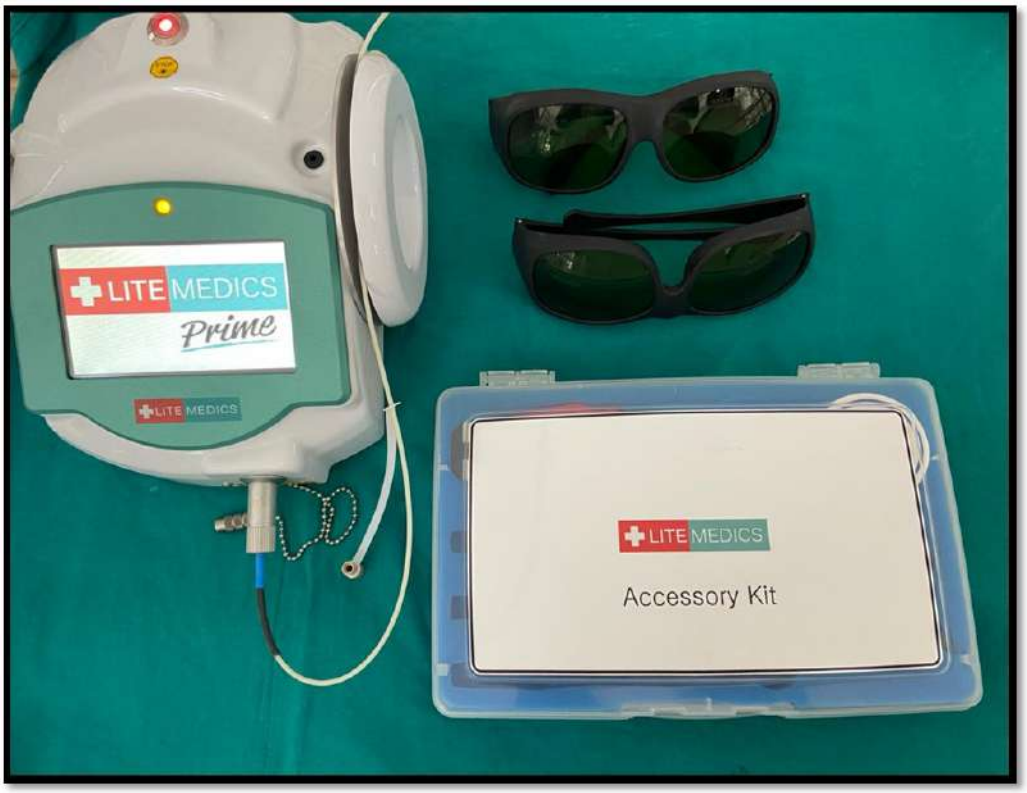
Group A was consisted of 15 subjects were treated with LLLT.

Group B consisted of remaining 15 patients on whom Triamcinolone Acetonide 0.1% was advised.

Patient Assessment-

In each participant an initial baseline assessment was carried out through personal interview & clinical assessment.

- Informed written consent was obtained from each of the participant.
- The symptom score for RAU was considered as baseline using VAS scale on the first day.
- **Group A** participants were treated with LLLT with setting of 980 nm, 300-micron thickness fibre 1 watt 3 min low level laser therapy.
- After LLLT VAS scale was recorded on patient.
- LLT was done on 1^{st}, 3^{rd} and 7^{th} day.
- **Group B** participants were asked to apply Triamcinolone Acetonide 0.1% to the ulcer 3 times a day for 7 days with clean fingertip.
- Group B participants were also recalled on 3^{rd} and 7^{th} day.
- Follow up was done for both the groups on 14^{th} day.



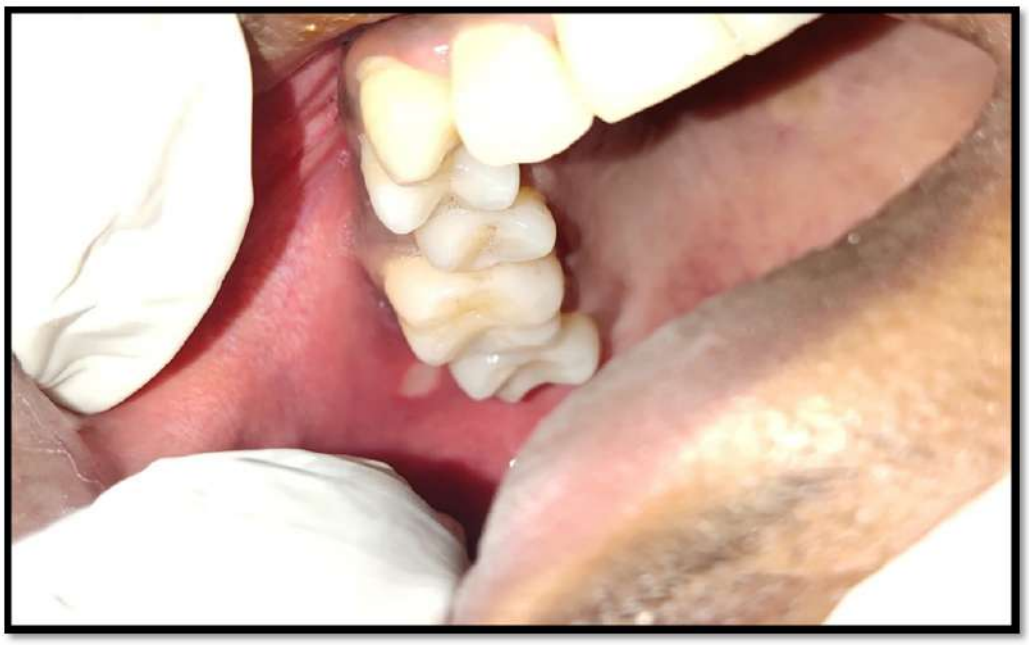
Photograph 1: Diode Laser (LITE MEDICS) 980nm

Photograph 2: Armamentarium

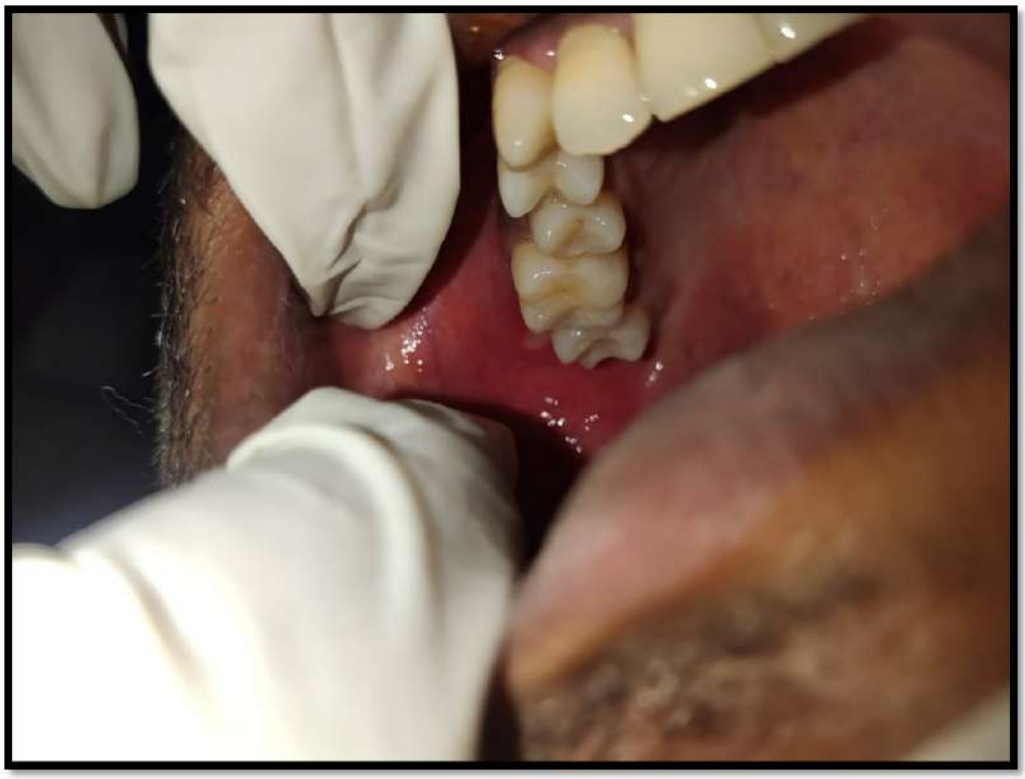
Photograph 3: Protective Eyewear

Photograph 4: Patient with Protective Eyewear

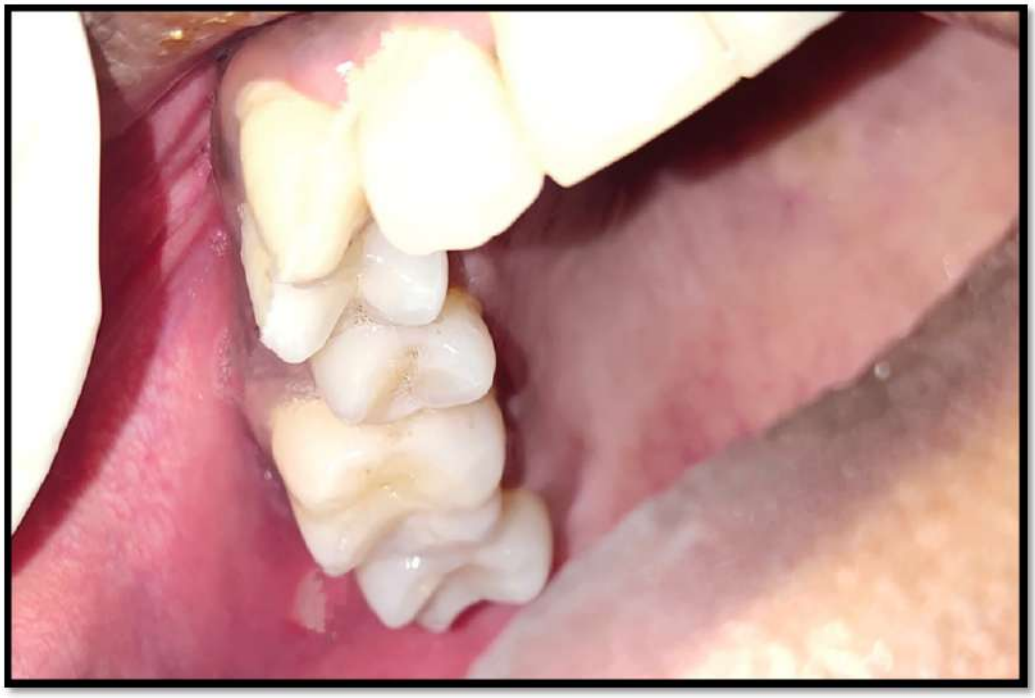
GROUP A (LASER THERAPY)



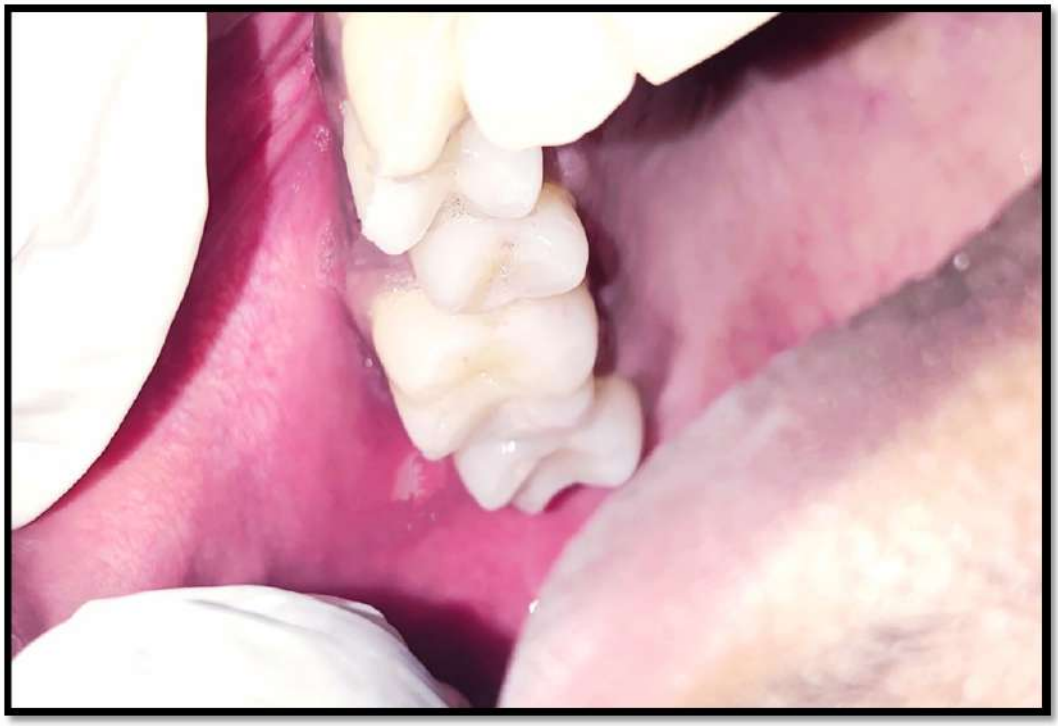
Photograph 5: DAY 1 (BEFORE LASER THERAPY)



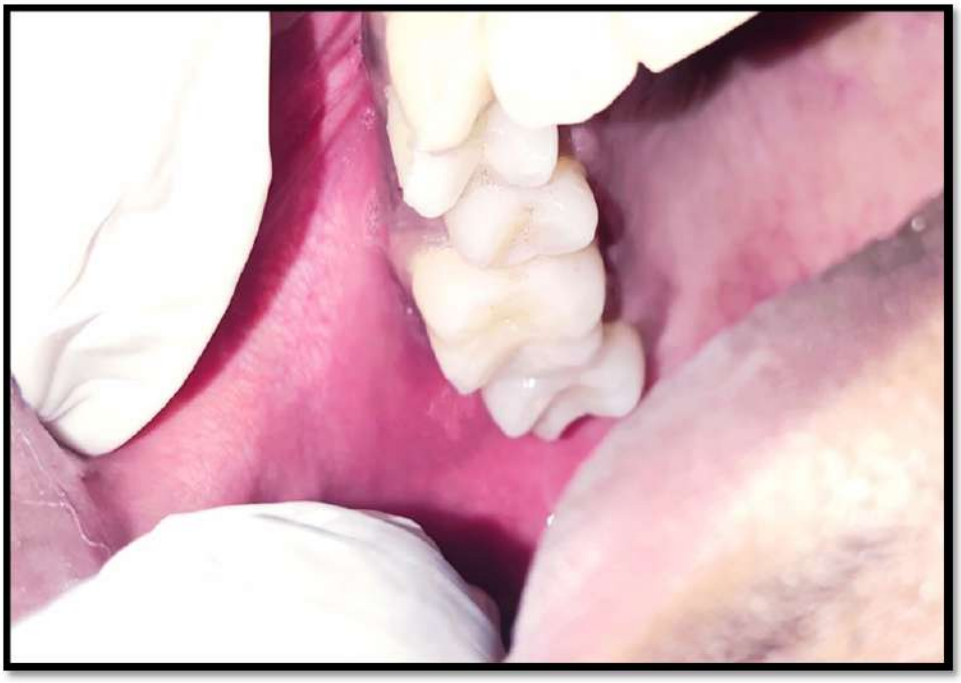
Photograph 6: DAY 1 (AFTER LASER THERAPY)



Photograph 7: DAY 3 (BEFORE LASER THERAPY)



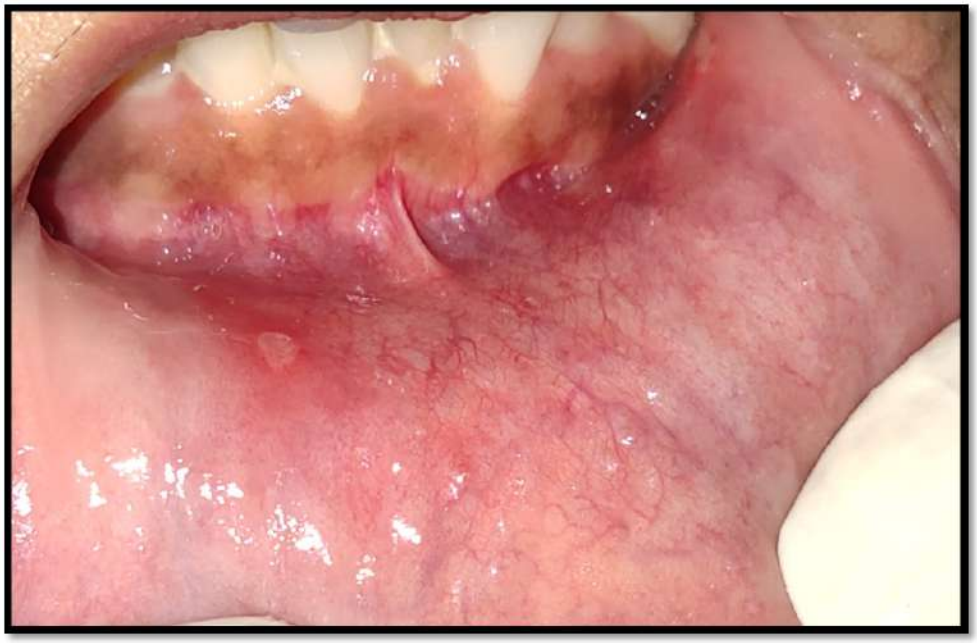
Photograph 8: DAY 3 (AFTER LASER THERAPY)



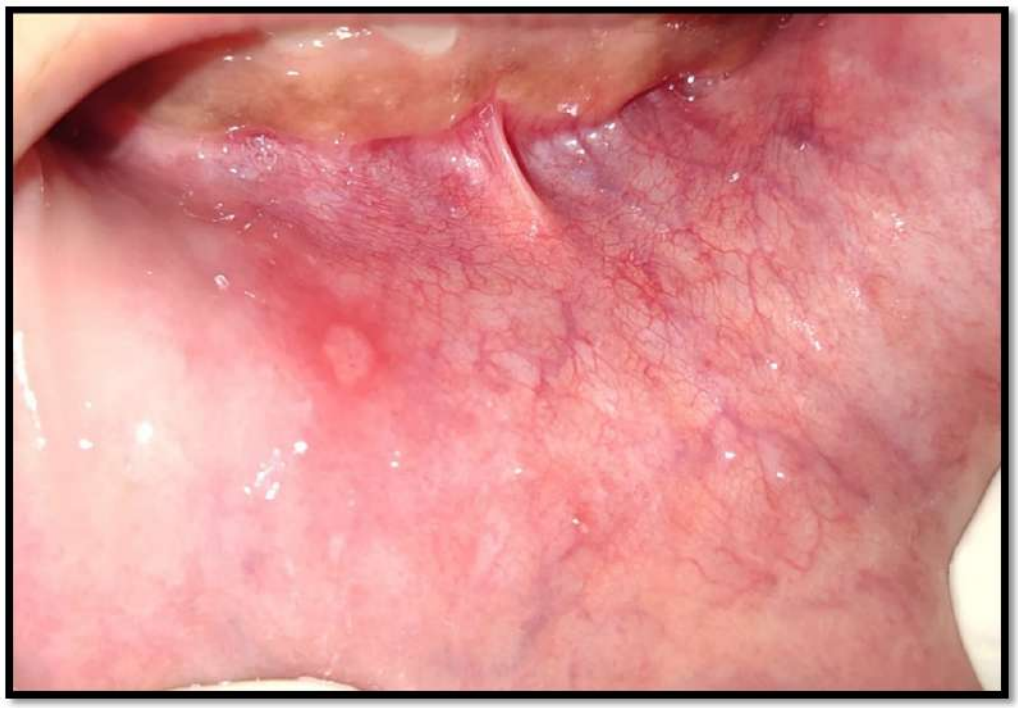
Photograph 9: DAY 7

GROUP B

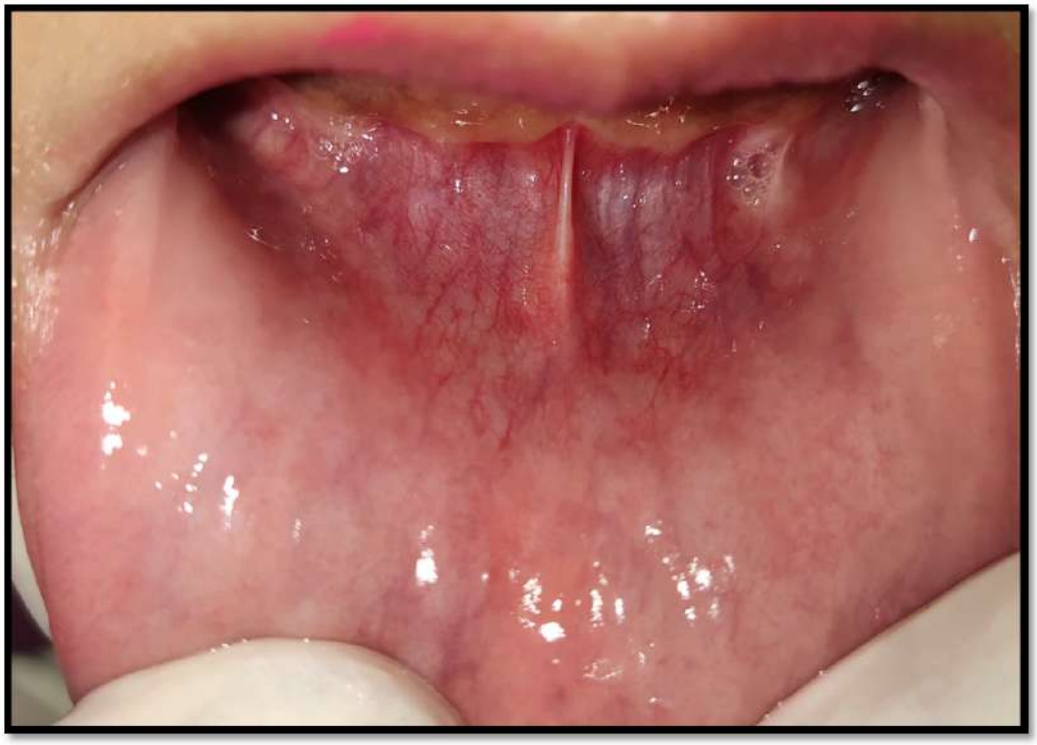
Photograph 10: Oint. TRIAMCINOLONE ACETONIDE 0.1%



Photograph 11 :DAY 1



Photograph 12 : DAY 3 (Ist FOLLOW UP)



Photograph 13 : DAY 7 (2nd FOLLOW UP)

STATISTICAL ANALYSIS

The results for the study are presented in mean, SD and percentages. The Chi-square test is g compare dichotomous/categorical variables. The unpaired t-test is used to compare two continuous variables. A two tailed p-value<005 is being considered as statistically significant. All the analysis is carried out by using SPSS (Statistical Package for Social Science) 16.0 version.

The Arithmetic Mean

The most widely used measure of central tendency is arithmetic mean, usually referred to simply as the mean. The sample mean is the average and is compared as the sum of all the observed outcomes from the sample divided by the total number of events. We use x as the symbol for the sample mean. It is calculated as

$\bar{x} = (\Sigma xi) / n$

or

x=sum of terms / number of terms

The Standard Deviation

The standard deviation (SD) is the positive square root of the variance, calculated as

$$SD = \sqrt{\frac{\Sigma X_i^2 - \frac{(\Sigma X_i)^2}{n}}{n-1}}$$

where n = Number of observations

Chi Square test of Homogeneity

The test is applied to a single categorical variable from two or more different populations. It is used to determine whether frequency counts are distributed identically across different populations.

Level of significance: "p" is level of significance.

• $p>0.05$ :: Not significant

• $p<0.05$ :: Significant

• $p<0.01$ :: Highly significant

• $p<0.001$ :: Very highly significant

One Way ANOVA :

The one-way analysis of variance (ANOVA) is used to determine whether there are any significant differences among the means of various (more than two) independent groups. In this case the bi-group comparisons were performed by Tukey HSD test. For applying ANOVA, the data must follow the assumption of normality.

Wilcoxon signed-rank test:

The non-parametric Wilcoxon signed-rank test was used for comparing two related matched samples to assess whether their populations mean ranks differ. It is used as an alternative to the paired Student's t-test in case when the population cannot be assumed to be normally distributed.

Friedman test:

The Friedman test is a non-Parametric statistical test Similar to the parametric repeated measures ANOVA, it is used to detect differences in treatments across multiple test attempts. The procedure involves ranking each row (or block) together, then considering the values of ranks by columns.'

OBSERVATION
&
RESULT

The present study was carried out in the Department of Oral Medicine and Radiology, Babu Banarasi Das College of Dental Sciences, Lucknow. The study was conducted on thirty patients with clinically diagnosed minor Recurrent Aphthous Ulcer.

Statistical Analysis

The results were analyzed using descriptive statistics and making comparison between the groups with respect to previous parameters. Discrete (categorical data were summarized as in proportions and percentages (%) and quantitative data were summarized as Mean ± SD (standard deviation). A two-tailed p value less than 0.05 (p,0.05) was considered statistically significant.

All the analysis was carried out om SPSS 16.0 version (Chicago, Inc., USA).

Observations:

Total no. of patients=30

Distribution of Patients according to Age Groups

Age Group	**No.**	**%**	**p-value**
18-30 years	26	87%	0.122
30-50 years	4	13%	
Total	30	100	

TABLE I (A) : Distribution of Patients according to Age Groups

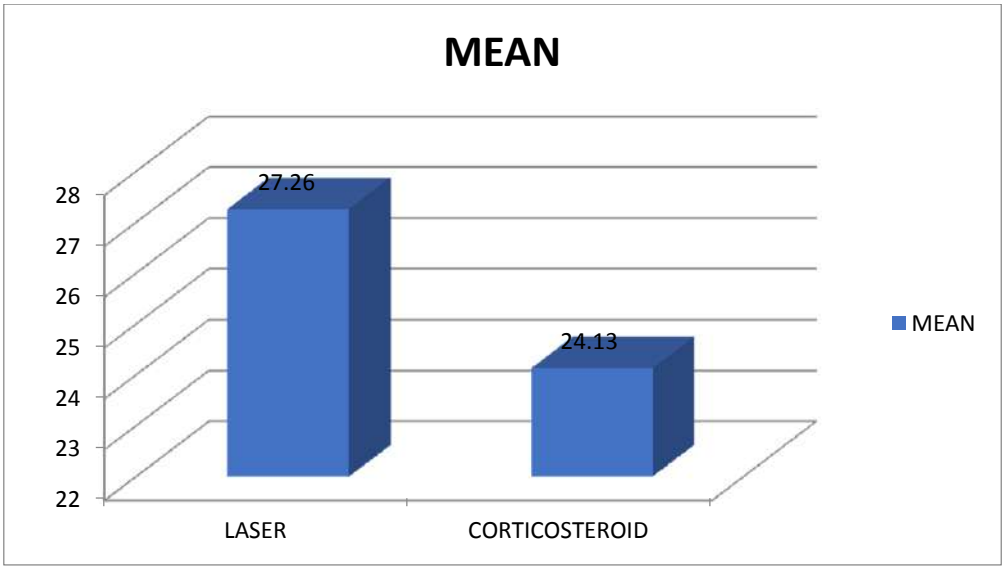
Among the 30 patients, maximum 87% patients belonged to the age group >30 years, while 13% patients belonged to the age group 30-50 years. However no significant

difference in proportion of patients among the various age groups was found (p=0.164).

Age

	Laser group	**Corticosteroids group**	**p-value**
Mean	27.26	24.13	0.164
SD	7.25	4.42	

TABLE I (B) : Distribution of Patients according to Age Groups



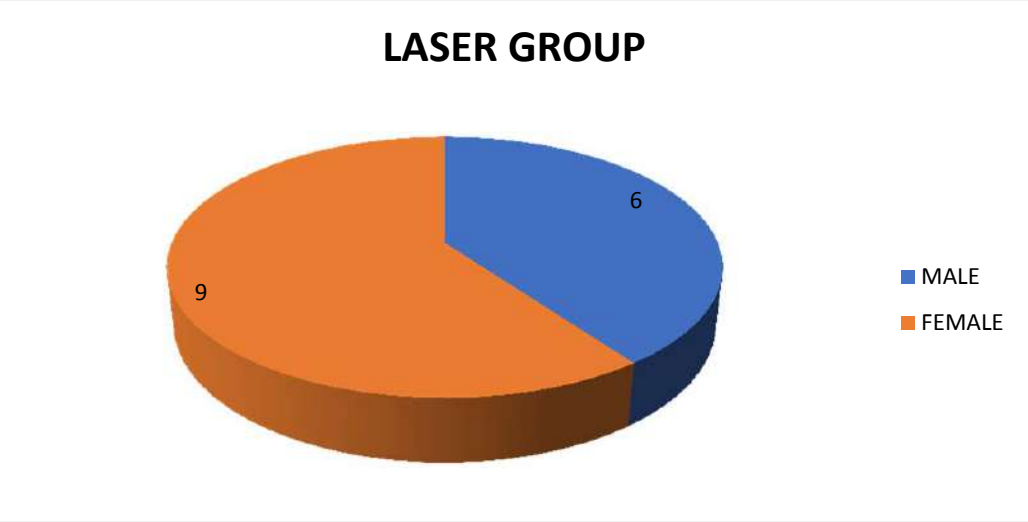
GRAPH 1: Age Distribution of Patients

The above table shows the mean age distribution among the two groups with 27.26±7.25 mean age in the laser group and 24.13±4.42 mean age in the corticosteroid group. The age distribution is statistically (p>0.05).

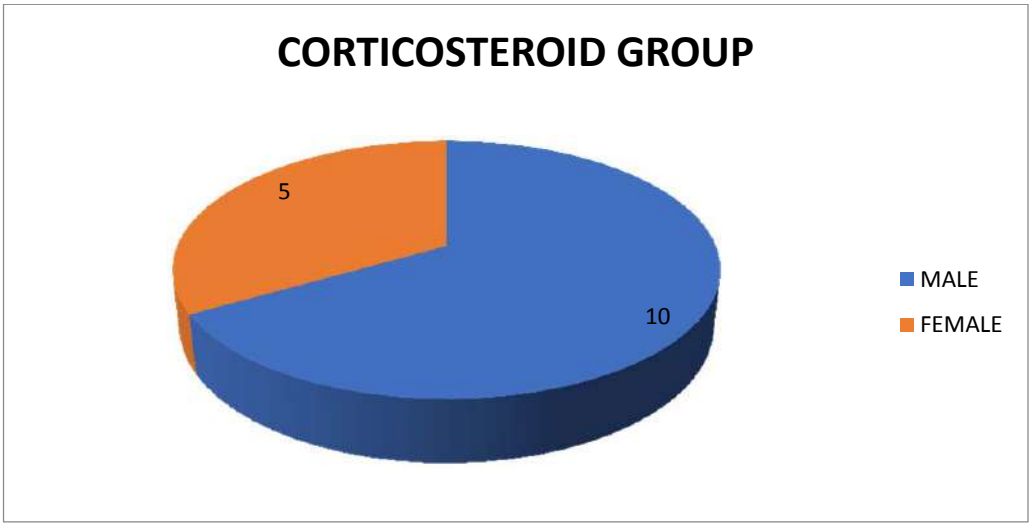
Sex distribution of patients

	Laser group	Corticosteroids group	p-value
Male	6	10	0.143
Female	9	5	

TABLE II : Sex distribution of patients



GRAPH 2: Sex Distribution of Patients (LASER Group)



GRAPH 3: Sex Distribution of Patients (Corticosteroid Group)

The above table shows the gender distribution among the two groups. The data shows that there were 6 males and 9 females in the laser group and 10 males, 5 females in the corticosteroid group. Among 30 patients, 53% were males while 46.6 % were females. Now male to female ratio of the study group was 8:7 The gender distribution is statistically non- significant ($p>0.05$).

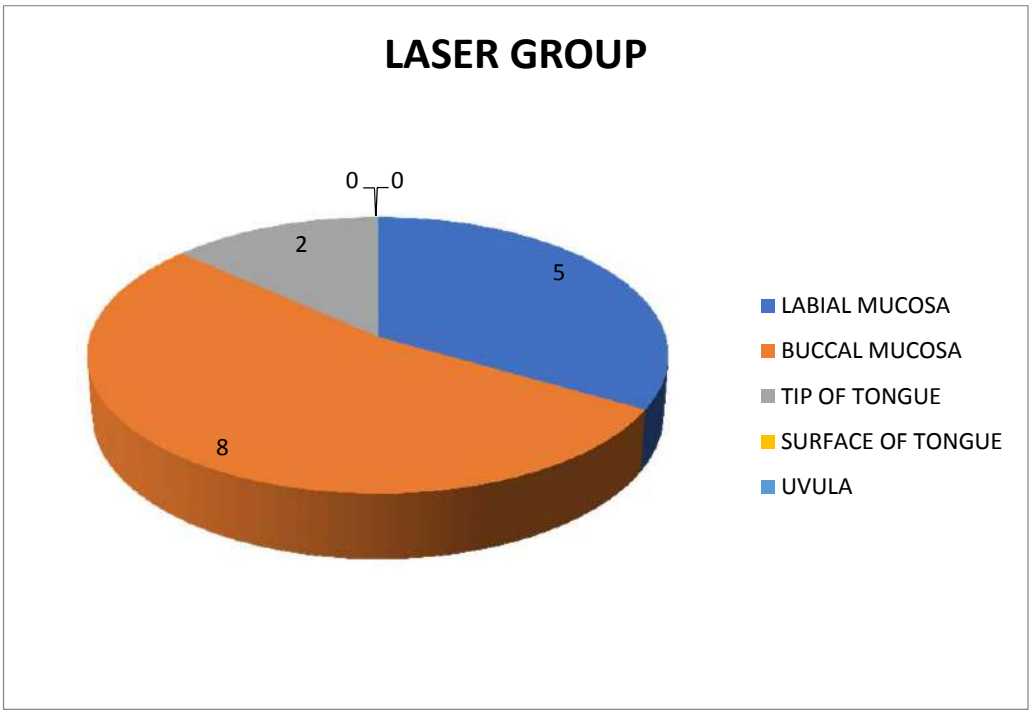
SITE

The distribution of site and side of lesion is shown in Table & Figure.

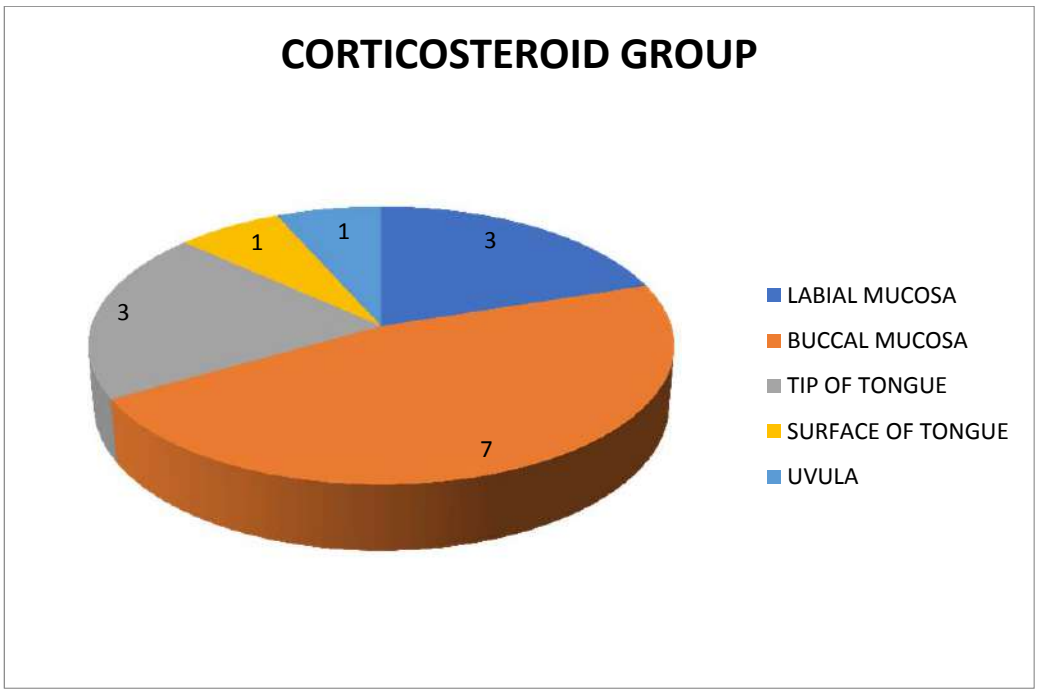
	Laser group	**Corticosteroids group**	**%**
LABIAL MUCOSA	5	3	26.6%
BUCCAL MUCOSA	8	7	50%
TIP OF TONGUE	2	3	16.6%
SURFACE OF TONGUE	0	1	3.3%
UVULA	0	1	3.3%

TABLE III : Distribution of site and side of lesion.

The most common site among patients was Buccal Mucosa (50%) with equal involvement of right and left sides (25% each). The less common site was uvula and surface of tongue (3.3% each).



GRAPH 4: Site Distribution (LASER Group)



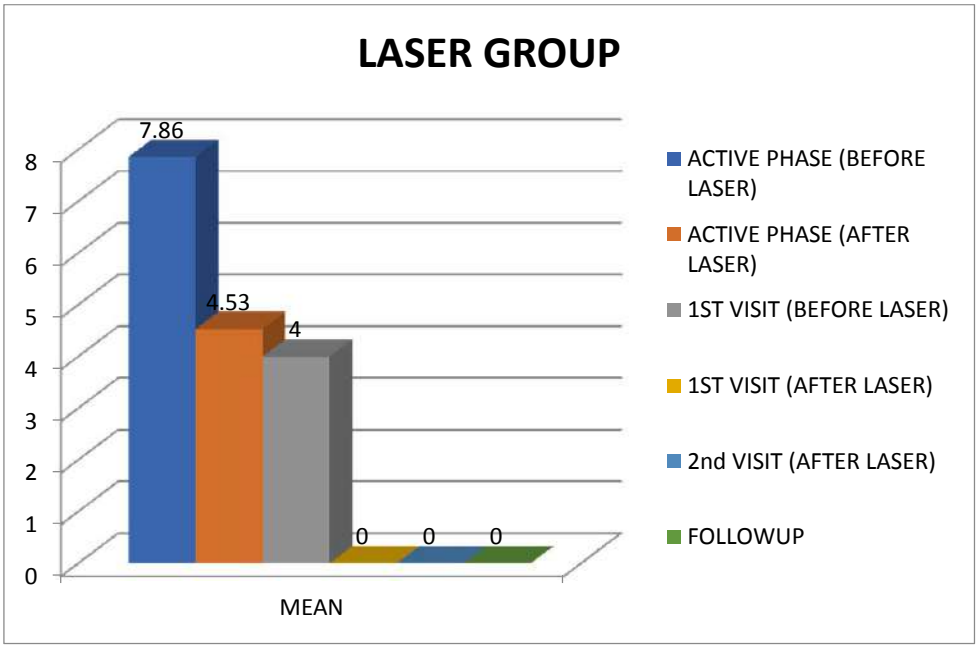
GRAPH 5: Site Distribution (Corticosteroid Group)

Laser group comparison

	Mean	**SD**	**P-value**
Active phase (before laser)	7.86	.83	**0.000**
Active phase (after laser)	4.53	.91	
1st visit (before laser)	4.00	.92	**0.000**
1st visit (after laser)	.00	.00	
1st visit (before laser)	4.00	.92	**0.000**
2nd visit (after laser)	.00	.00	
1st visit (before laser)	4.00	.92	**0.000**
Follow-up	.00	.00	
1st visit (after laser)	.00	.00	-
2nd visit (after laser)	.00	.00	
1st visit (after laser)	.00	.00	-
Follow-up	.00	.00	
2nd visit (after laser)	.00	.00	-
Follow-up	.00	.00	

TABLE IV : Laser group comparison

According to Wilcoxon signed rank test this change is highly significant as P- value is 0.000.



GRAPH 6: Patients Improvement status of According to VAS score (Pain) in LASER group

The above table shows the intragroup comparison in the laser group based on the mean VAS score. The mean VAS score is seen decreasing in the active phase after the laser from mean of 7.86 before laser to 4.53 after laser. The mean VAS score shows a decrease from 1st visit (before laser) to 1st visit , 2nd visit and follow up (after laser). Also, the results are non-significant between 1st visit – 2nd visit after laser, 1st visit-follow up after laser, 2nd visit and follow up after laser as there was no mean difference seen between the two VAS scores ($p>0.05$).

Corticosteroid group

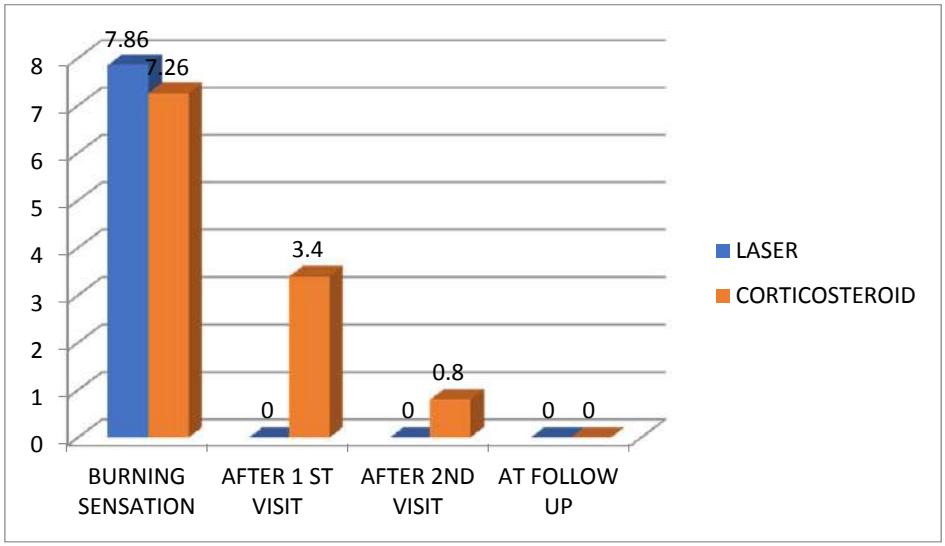
	Mean	**SD**	**P-value**
1st visit	3.40	1.05	**0.000**
2nd visit	.80	.86	
1st visit	3.40	1.05	**0.000**
Follow-up	.00	.00	
2nd visit	.80	.86	**0.003**
Follow-up	.00	.00	

TABLE V: Corticosteroid group

Intergroup comparison

	Laser group (mean ± SD)	Corticosteroid group (mean ± SD)	p-value
Burning sensation	7.86±0.83	7.26±0.88	0.066
After 1 st visit	0.00±0.00	3.40±1.05	**0.000**
After 2 nd visit	0.00±0.00	0.80±0.86	**0.001**
At follow up	0.00±0.00	0.00±0.00	-

TABLE VI : Intergroup comparison



GRAPH 7: Improvement status of patients (inter group comparison)

The above table shows the inter group comparison among the two groups. The results shows non-significant difference in the burning sensation VAS score between the two groups ($p>0.05$). After 1st and 2nd visit the VAS score was seen more in the corticosteroid group as compared to the laser group ($p<0.05$) with statistically significant difference. At follow-up the results shows no difference at all between the two groups. The result conclude that the mean VAS score was more in the corticosteroid group as compared to laser group in the 1st and 2nd visit.

RESULT

30 patients with a diagnosis of minor recurrent aphthous ulcer were divided into two groups (Group A & Group B), Group A 15 patients were given LLLT and Group B 15 patients were advised Triamcinolone Acetonide 0.1%.

The Group A consist of (60% females and 40% males) with a mean age ± standard deviation = 27.26 ± 7.25 Group B consist of (34% females and 66% males) with a mean age ± standard deviation = 24.13 ± 4.42. No statistical difference was observed

concerning the age of the two groups ($p > 0.05$). The gender distribution is statistically non- significant (p.0.05).

The mean VAS score is seen decreasing in the active phase after the laser from mean of 7.86 before laser to 4.53 after laser. The result also shows that the change in VAS score was statistically significant in the active phase before and after laser, 1st visit- before and after laser, 2nd visit after laser follow-up ($p<0.05$). where as in corticosteroid group shows more VAS score as compared to laser group.

The aim of our study was to compare the treatment efficacy and pain relief of Low Level Laser Therapy & Triamcinolone Acetonide 0.1% therapy in patients suffering from Recurrent Aphthous Ulcer, with objectives of the efficacy of LLLT & Triamcinolone Acetonide 0.1% in patients with RAU, also to compare the efficacy among both the groups. Now both groups presented a statistically significant difference from baseline to follow up periods. But diode laser treatment showed more remarkable improvements in reduction of healing time, pain and lesion size. therefore, the result shows difference between the healing time, VAS score between both the groups which shows Laser therapy has better efficacy than Triamcinolone Acetonide 0.1%.

DISCUSSION

INTRODUCTION

Aphthous ulcer (AU), also known as recurrent aphthous stomatitis (RAS), is a painful, benign, inflammatory lesion of the oral mucosa. RAS is a disease of the oral mucosa characterized by recurrent, painful, single, or multiple well-demarcated ulceration with peripheral red halo where healing takes place with or without scarring. RAU occurs in the non-keratinized areas as lips, tongue, buccal mucosa and soft palate. They are usually painful, shallow round ulcers with an erythematous halo covered by a yellowish- grey fibro membranous layer.[1]

A prodromal burning sensation lasting 24 to 48 hours can often precede the onset of ulcers. Minor RAS, which makes up more than 80% of all RAS cases, is a small (up to 1 cm in diameter), experience of aphthous ulcer may affect an individual's capacity to perform daily activities like eating and speaking.[3]

Management and treatment of aphthous ulcers is challenging, due to distinct aetiology However, it is considered to be multifactorial disease. The primary treatment goal for RAS is to reduce inflammation and duration of ulcer and to promote healing. Distinct treatment modalities such as anti-inflammatory drugs, aesthetics, immune modulators, antibiotics, and a few herbal therapies, are being prescribed.

CORTICOSTEROID

Triamcinolone acetonide is a fluoride synthetic corticosteroid. Its cream (0.1%) and ointment (0.1%) forms are available for topical use. The absorption rate varies from 1% in palms and knee to 36% in face, eyelash and genital area. Its absorption increases via damaged, inflamed or dressed skin. Triamcinolone acetonide has anti-

inflammatory properties and therefore could help to limit the full extent to which aphthous ulceration would progress. Metabolism of triamcinolone after topical application is dermal. The small amount which may enter systemic circulation is metabolized in liver. Topical application's side effects are burning, itching, irritation, dryness, folliculitis, hirsutism hyperpigmentation, perioral dermatitis, contact allergic dermatitis, secondary infections and atrophy. **R.M. Browne et al (2011)** conducted a double-blind clinical trial of topical Triamcinolone acetonide in the treatment of recurrent aphthous stomatitis. The results suggest that this preparation should be used in the treatment of severe episodes of recurrent aphthous stomatitis and not for long-term management of these patients.[84] Topical cortisteroid can be effective drugs in the treatment RAS. Patient response is variable and, there are some individuals who gain little or no relief from their use.[85]

Low Level Laser Therapy

Recently, Low Level Laser Therapy (LLLT) have been used in the treatment of Recurrent aphthous stomatitis because they improve the efficacy of healing, relieves the pain by producing analgesia and burning sensation, reduce the recurrence and eliminates the potential adverse effects caused by drugs. It is also reported to be relatively safe with no clinical complications because of the low energy output. The laser has been widely used in the health field, mainly for therapeutic purposes or for bio stimulation because of its characteristics of low-level energy and wavelengths capable of penetrating tissues. Many studies have demonstrated the anti-inflammatory capacity of laser light as well as its action in the reduction of pain and stimulus for tissue repair.

The current study consisted of 30 Patients suffering from minor recurrent Aphthous ulcers who visited the department of Oral Medicine and Radiology, Babu Banarasi Das College of Dental Sciences, Lucknow, UP.

However, the aim of the study was to compare the treatment efficacy and pain relief of Low Level Laser Therapy & Triamcinolone Acetonide 0.1% therapy in patient suffering from Recurrent Aphthous Ulcer with objective To assess the efficacy of LLLT in patients with RAU, To assess the efficacy of Triamcinolone Acetonide 0.1% in patients with RAU, To compare the effects of LLLT and Triamcinolone Acetonide 0.1% in both groups.

For the study purpose 30 subjects were examined which was divided into 2 groups. Group A consist of 15 subjects on which Low Level Laser Therapy was used & Group B consist of 15 subjects on which Triamcinolone Acetonide 0.1% was used. Accordance to our study, **Aggrawal H, et al (2014)** conducted a study in which they included 30 patients and divided them into 2 groups patients were divided into either the active treatment group or the sham control group.[65] **Soliman HA, Mostafaa (2019)** included 20 patients and divided them into 2 groups study groups, group A received 660 nm diode laser irradiation while group B control group received placebo group.[68] Contradicting to our study **Jijin MJ, Rakaraddi M, Pai J, Jaishankar HP, et al (2016)** included 50 participants suffering from minor aphthous ulcers & divided into 2 groups. Group A were treated with amlexanox oral paste & group B with LLLT.[64]

A case history format was specifically designed for the study. In our study we are comparing the pain assessment in pain relief in recurrent aphthous ulcer by the use of diode laser and corticosteroid.

For assessing the parameters (reduction in erythema, pain and burning sensation), Visual Analogue Scale (VAS) was used in our study. Similarly, **Lalabonova H &Daskalov H (2014), Misra N, Maiti D, Misra P, Singh AK (2013)**, **Xiao Huo et al in (2020), Soliman HA, Mostafaa (2019)**, **Pasquale C et al (2021)**, conducted study by using VAS to record pain in the patients.

Tappuni AR et al (2014) used 6 ulcer characteristics, number, size, duration, ulcer free period, site and pain for generating an ulcer severity score (USS).[56]

AGE:

In this study, age range between 18-50 years and the age and gender wise distribution of study subjects group A and group B showed that maximum patients were in the age group of 18-30 years with 16 males and 14 females. The prevalence of aphthous stomatitis is more in younger population. In the present study 30 subjects with a minor recurrent Aphthous ulcer were in the age range of 18years-50years among the 30 patients, maximum (87%) patients were belonged the age group <30 years remaining 13% patients were belonged age group >30 years (Table 1). The mean age of patients in each group was 27.26 ± 7.25 in laser group and 24.13 ±4.42 in the corticosteroid group (Table 2). The age distribution was statistically non- significant ($p>0.05$). accordance to our study **Khammas et al in (2019)** conducted a study where patients age ranges from 15 to 49 years, with a mean age of 27.15 years in Group A; 24.8 years and in Group B; 29.5 years. **Agrawal N. et al in (2019)** conducted a study to prevalence of RAS was more in the second decade 51 (66.23%) as compared to the third decade 26 (33.76%).[64] **Xiao Huo et al in (2020),** conducted study in which patients were divided into 2 groups, group A shows 16 patients out of 25 patients

were under 40 years and 9 patients were over 40 years. In group B 13 patients were under 40 years and 13 patients were over 40 years.[70]

SEX:

Out of 30 patients involved in the study were 16 males and 14 females. Male to female ratio was 8:7 (Table 3) table shows among 30 patients, 53% were males while 47% females. The gender distribution was statistically significant (p>0.05). This is comparable to as observed by **Jijin MJ et al, in 2016** in which out of 50 patients 29 were male and 21 were female.[70] Accordance to our study a study conducted by **Soliman A.H. Mostafaa D. in 2019** sex distribution shows 13 Males and 7 Females.[76] **Aggrawal H, Singh MP, Nahar P, Mathur H, Gv S (2014)** conducted a study in which out of 30 patients 18 were males and 12 were females. Highest number of Recurrent Aphthous Ulcer was found in males. According to the survey by **Chattopadhyay and Chatterjee**, the incidence of RAS was greater in men.[65]

Contradicting to our study a study published by **Andreas Altenburg, in (2014)** out of 180 patients 82.8% were Females and 17.2% were Males. **Gichki et al**. reported equal sex predilection in their study. **Malayil et al.** stated that the female predilection may be due to some hormonal reasons such as the luteal phase of the menstrual cycle, association with progesterone levels in pregnancy and much more.[68]

SITE:

In our study the common site of involvement was Buccal Mucosa (15 patients) i.e 50% with equal involvement of right and left sides (25% each) followed by Labial Mucosa (8 patients) i.e 26.6%, tongue (2 patients) 16.6% and soft palate (1 patient) i.e

3.3%. Accordance to our study a study conducted by **Lalabonova H & Daskalov H in (2014),** involve most common site was buccal mucosa followed by labial mucosa. **H, Singh MP, Nahar P, Mathur H, Gv S (2014)** conducted a study in which out of 30 patients in which common site was buccal mucosa followed by labial mucosa, tongue. **Xiao Huo et al in (2020)** concluded Aphthous ulcer are often seen Buccal or labial mucosa 13 patients followed by tongue, gingiva and floor of mouth.

SIZE:

In our study the size and erythematous area was reduced immediately after laser therapy in group A where as in group B Triamcinolone Acetonide 0.1%. it took more time to reduce size and erythematous area. Accordance to our study **Aggrawal H, Singh MP, (2014)** conducted a study to assess the efficacy of Low-level laser therapy (LLLT) on recurrent aphthous ulcers for reduction of pain, lesion size, and healing time clinically and compared the results with a sham control group. They concluded that LLLT was effective in relieving pain and reducing the healing time during the treatment of aphthous ulcers. **Xiao Huo et al in (2020),** conducted a study on Effect of different treatments on recurrent aphthous stomatitis: laser versus medication where they found there was decrease in size of the lesion with decrease in redness as compared to mediational group. In agreement with our study **Anand et al. and Misra N et al.** reported that the most appropriate treatment modality with the greatest clinical effectiveness for RAS is therapeutic lasers.

CLINICAL FEATURE

In our study on baseline visit clinical findings were recorded in which lesion resembled typical clinical features of minor recurrent aphthous ulcer i.e size were smaller than 1 cm in diameter, affecting nonkeratinized oral mucosa, well

demarketed, shallow, ovoid to round with yellowish white in colour with erythematous halo. In agreement with our study **Misra N et al. (2013), Xiao Huo et al in (2020)** included patients with minor aphthous ulcer with the size of not more than 10 mm in diameter. In line with our study **H, Singh MP, Nahar P, Mathur H, Gv S (2014), Agrawal N. et al in (2019)** conducted a study in which they included clinically characteristic painful ulcers that were small, round-to-ovoid, affecting nonkeratinized oral mucosa, and surrounded by a distinct erythematous halo.

PAIN (VAS):

In our study the intragroup comparison in the laser group based on the mean VAS score. The mean VAS score is seen decreasing in the active phase after the laser from mean of 7.86 before laser to 4.53 after laser. The mean VAS score shows a decrease from 1st visit (before laser) to 1st visit, 2nd visit and follow up. The result also shows that the change in VAS score was statistically significant in the active phase before and after laser. After 1st and 2nd visit the VAS score was seen more in the corticosteroid group as compared to the laser group ($p<0.05$) with statistically significant difference. In agreement with our study **Lalabonova H &Daskalov H (2014)** conducted a study to clinically assess the therapeutic effect of low-level laser therapy (LLLT) on chronic recurrent aphthous stomatitis (RAS) 180 patients were included they found using LLLT to treat chronic RAS were better than those obtained in the group receiving pharmacotherapy.[64] In compliance with our study **Min Han, Hui Fang et al (2016)** reviewed Effectiveness of Laser Therapy in the Management of Recurrent Aphthous Stomatitis. They concluded that laser therapy has the superiority in relieving ulcer pain and shortening healing time when compared with placebo group or medical treatment group. Similarly, in our study patients reported

shorter healing time in laser group than patients in corticosteroid group.[72] In accordance with our study **Najeeb S, Khurshid Z et al (2016)** reviewed in which nine studies were deemed suitable for review. They concluded that although various types of lasers have succeeded in providing immediate pain relief to patients, carbon dioxide (CO2) lasers have the unique advantage of requiring a short. **Prasad S, Pai A (2013)** treated 25 patients with minor Aphthous Stomatitis were successfully treated with diode laser at 1-2W with immediate pain relief sustained over 24 Hrs, along with accelerated healing time. Similarly in our study 15 patients were given laser therapy the pain was reduced immediately after laser therapy.[61] **Mishra N, Maiti D, Mishra P, Singh AK (2013)** evaluated the safety convenience and effectiveness of 980nm diode laser for treatment of minor recurrent Aphthous stomatitis in one patient. They concluded that laser therapy decreases the burning sensation immediately likewise in our study 980nm was given to patients burning sensation was decreased immediately and patient was relieved.[75]

Contradicting to our study **Jijin MJ, Rakaraddi M, Pai J et al (2016)** compared the treatment effects of 5% amlexanox and low level blaser therapy (LLLT) in 50 patients with minor aphthous stomatitis, they concluded that both amlexanox & LLLT were equally effective in relieving pain associated with minor aphthous stomatitis.[71]

Now, on intergroup comparison after 1st and 2nd visit the VAS score was seen more in the corticosteroid group as compared to the laser group ($p<0.05$) with statistically significant difference.

Patient after treatment with laser therapy gave history of mild pain on the day of therapeutic treatment, pain decreased on consecutive follow ups. Negligible pain was found on first follow up (day 3) after laser therapy. Whereas, pain was present in Triamcinolone Acetonide group on first (day 3) and second (day7) follow up in some

patients. Accordance to our study **Pasquale C et al (2021)** conducted a study on 808-Nm Near-Infrared Laser Photo biomodulation versus Switched-Off Laser Placebo in Major Aphthae Management they concluded Patients of the photo biomodulation therapy group experienced a statistically significant reduction in pain and discomfort 24 and 48 h after treatment.[72] **Heba Hussein et al (2021)** conducted a study on Low-Level Diode Laser Therapy (LLLT) versus Topical Corticosteroids in the Management of Recurrent Aphthous Stomatitis they concluded LLLT can be considered a reliable alternative to topical steroids in the management of recurrent aphthous ulcers since it was more effective in reducing both pain intensity and ulcer size.[71]

Thus,980mn Diode Laser Therapy is safe, painless, treatment time is shorter, eliminates the potential adverse effect caused by the drugs and has better patient acceptance. No associative side effects were there with Laser therapy.

Overall findings of the study showed more efficacy of laser to get immediate pain relief as well as reducing the functional disability. Thus, in the treatment of minor recurrent aphthous ulcer the use of 980mn diode laser may be the best choice.

The limitation of the study was the patients were not followed for a longer duration for observation regarding recurrence. However, a study can be conducted by considering the prevalence of recurrence rate in laser-treated patients as one of the parameters, in addition to the parameters used in the present study.

CONCLUSION
&
SUMMARY

- In this study titled, **"a comparative study for assessment of pain relief in recurrent aphthous ulcer by use of low- level laser therapy (LLLT) therapy & triamcinolone acetonide 0.1%."** The aim was to compare and evaluate the efficacy of low level laser therapy and triamcinolone acetonide 0.1% topical gel in the management of minor recurrent aphthous ulcer. The total sample size was 30 patients diagnosed with minor recurrent aphthous ulcer, they were given consent to participate and met the eligibility criteria. A detailed history and clinical findings were recorded in individual performas designed especially for the study on the baseline visit. Patients for the study were divided into 2 groups Group A and Group B. Group A received Low level laser therapy while the patients in Group B received topical Triamcinolone Acetonide 0.1%. Both groups were evaluated for clinical symptoms and lesion presentation at baseline visit along with history of minimum 3 episodes.

  Patients were recalled for visit on day 3 and day 7 and a follow up was done after 21 days to check for any recurrence.

  Statistical analysis was done to confirm our study.

- The following conclusion were drawn:

  Objectives considering the evaluation of individual potency of both the treatments were met, as triamcinolone acetonide 0.1% and low level laser therapy were able to resolve burning sensation and lesion, in each patient. Other objective was to compare evaluation of both the modalities in order to access the one with better efficacy in the management of minor recurrent aphthous ulcer.

The topical triamcinolone acetonide 0.1% was found to be effective in the management of minor recurrent aphthous ulcer. It exhibits anti-inflammatory and anti- allergic effects but low level laser therapy was more effective than topical triamcinolone acetonide 0.1% as it shows immediate analgesic effects with no adverse effects. No adverse reactions were noted with the use of low level leaser therapy with immediate pain relief to the patient.

- This study confirms that laser therapy is more efficient then topical triamcinolone acetonide 0.1%, well tolerability with quick result. The treatment of minor aphthous ulcers is usually symptomatic, including topical and systemic corticosteroids depending upon the severity of the lesions. However, extreme caution should be taken when using systemic steroids because of the serious side effects encountered and the possibility of local candidiasis.
- Because of these side effects, the possibility of prolonged treatment with steroids, and the fact that the disease process could still last for years, an alternative therapy is desirable. Laser has been used for the treatment of oral aphthous ulceration in patients who wish to avoid the use of steroid medication.
- Over past few decades, the use of lasers has grown dramatically. It is safe, reliable, painless, non- invasive, easy to administer, shorter treatment time and exact control of laser fluency in all the areas of mouth in the management of minor recurrent aphthous ulcer. Hence, we conclude that our results provided empirical hint for the better management of minor recurrent aphthous ulcer.

- From our study it can be inferred that Diode Lasers provide immediate pain relief and accelerates healing time with minimal to no side effects. Further large scale studies are needed to be done.

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ANNEXURES

ANNEXURE - I

DEPARTMENT OF ORAL MEDICINE AND RADIOLOGY,

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES,

LUCKNOW

TITLE: - A COMPARATIVE STUDY FOR ASSESSMENT OF PAIN RELIEF IN RECURRENT APHTHOUS ULCER BY USE OF LOW- LEVEL LASER THERAPY(LLLT) & TRIAMCINOLONE ACETONIDE 0.1% THERAPY

CASE HISTORY PERFORMA

Case No: OPD No:

Name of Patient: Age:

Occupation: Sex:

Address: Marital Status:

Contact No:

CHIEF COMPLAINT:

HISTORY OF PRESENT ILLNESS:

PAST MEDICAL HISTORY:

PERSONAL HISTORY:

ORAL HYGIENE HABITS:

SOFT TISSUE EXAMINATION:

Lips:

Labial Mucosa:

Buccal Mucosa:

Vestibule:

Tongue:

Floor Of Mouth:

Hard And Soft Palate:

ON INSPECTION:

ON PALPATION:

PROVISIONAL DIAGNOSIS:

DIFFERENTIAL DIAGNOSIS:

FINAL DIAGNOSIS:

TREATMENT PLAN:

FOLLOW UP:

DAY	**V.A.S. (Before)**	**V.A.S. (After)**
DAY 1		
DAY 3		
DAY 7		
DAY 21		

STUDENT SIGNATURE STAFF SIGNATURE

ANNEXURE - II

DEPARTMENT OF ORAL MEDICINE AND RADIOLOGY,

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES,

LUCKNOW

TITLE: - A COMPARATIVE STUDY FOR ASSESSMENT OF PAIN RELIEF IN RECURRENT APHTHOUS ULCER BY USE OF LOW- LEVEL LASER THERAPY(LLLT) & TRIAMCINOLONE ACETONIDE 0.1% THERAPY

CASE HISTORY PERFORMA

Case No: OPD No:

Name of Patient: Age:

Occupation: Sex:

Address: Marital Status:

Contact No:

CHIEF COMPLAINT:

HISTORY OF PRESENT ILLNESS:

PAST MEDICAL HISTORY:

PERSONAL HISTORY:

ORAL HYGIENE HABITS:

SOFT TISSUE EXAMINATION:

Lips:

Labial Mucosa:

Buccal Mucosa:

Vestibule:

Tongue:

Floor Of Mouth:

Hard And Soft Palate:

ON INSPECTION:

ON PALPATION:

PROVISIONAL DIAGNOSIS:

DIFFERENTIAL DIAGNOSIS:

FINAL DIAGNOSIS:

TREATMENT PLAN:

FOLLOW UP:

DAY	**V.A.S.**
DAY 1	
DAY 3	
DAY 7	
DAY 21	

STUDENT SIGNATURE STAFF SIGNATURE

ANNEXURE - III

Babu Banarasi Das University
Babu Banarasi Das College of Dental Sciences,
BBD City, Faizabad Road, Lucknow – 226028 (INDIA)

Dr. Lakshmi Bala
Professor and Head Biochemistry and
Member-Secretary, Institutional Ethics Committee

Communication of the Decision of the VIII[th] Institutional Ethics Sub-Committee

IEC Code: 11 **BBDCODS/03/2020**

Title of the Project: A Comparative Study for Assessment of Pain Relief in Recurrent Aphthous Ulcer by Use of Low-Level Laser Therapy (LLLT) & Triamcinolone Acetonide 0.1% Therapy.

Principal Investigator: Dr. Mona Singh **Department:** Oral Medicine & Radiology

Name and Address of the Institution: BBD College of Dental Sciences Lucknow.

Type of Submission: New, MDS Project Protocol

Dear Dr. Mona Singh,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 18[th] March, 2020.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry, BBDCODS, Lucknow
2.	Dr. Amrit Tandan Member	Prof. & Head, Department of Prosthodontics and Crown & Bridge, BBDCODS, Lucknow
3.	Dr. Sahana S. Member	Reader, Department of Public Health Dentistry, BBDCODS, Lucknow
4.	Dr. Sumalatha M.N. Member	Reader, Department of Oral Medicine & Radiology, BBDCODS, Lucknow

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.

The comments were communicated to PI thereafter it was revised.

Decisions: The committee approved the above protocol from ethics point of view.

Forwarded by:

Lakshmi Bala 18/03/20

(Dr. Lakshmi Bala)
Member Secretary
IEC

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

(Dr. B. Rajkumar)
Principal
BBDCODS

PRINCIPAL
Babu Banarasi Das College of Dental Sciences
(Under Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow-226028

ANNEXURE - IV

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES
(FACULTY OF BBD UNIVERSITY), LUCKNOW

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"A Comparative Study for Assessment of Pain Relief in Recurrent Aphthous Ulcer by Use of Low-Level Laser Therapy (LLLT) & Triamcinolone Acetonide 0.1% Therapy"** submitted by **Dr Mona Singh** Post graduate student from the **Department of Oral Medicine & Radiology** as part of MDS Curriculum for the academic year 2019-2022 with the accompanying proforma was reviewed by the Institutional Research Committee present on **19th December 2019** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

Prof. Vandana A Pant
Co-Chairperson

Prof. B. Rajkumar
Chairperson

MASTER CHART - LASER

CASE NO.	OPD NO.	DATE	NAME	GENDER	AGE	HISTORY	ENTATION *	SITE
						SYMPTOMS DURATION		
1	11405	2/20/2021	PREM LATA	FEMALE	50yrs	PAIN IN RIGHT SIDE OF CHEEK SINCE 2 DAYS	VAS=7	RIGHT BUCCAL MUCOSA
2	13835	2/4/2021	SAMSUDEEN	MALE	24yrs	PAIN IN LEFT SIDE OF CHEEK SINCE 2 DAYS	VAS=9	LEFT BUCCAL MUCOSA
3	16435	2/15/2021	RIZEWAN	MALE	20yrs	PAIN IN LEFT SIDE OF CHEEK SINCE 2 DAYS	VAS=9	LEFT BUCCAL MUCOSA
4	15222	3/2/2021	SHRADDHA VERMA	FEMALE	28yrs	PAIN IN LEFT SIDE OF CHEEK SINCE 2 DAYS	VAS=8	LEFT BUCCAL MUCOSA
5	17204	6/30/2021	KARTIK AWASTHI	MALE	26yrs	PAIN ON TONGUE REGION SINCE 2-3 DAYS	VAS=8	TIP OF TONGUE
6	14229	7/7/2021	MAHIMA CHAUHAN	FEMALE	20yrs	PAIN IN UPPER FRONT REGION SINCE 2 DAYS	VAS=8	UPPER LABIAL MUCOSA
7	11668	7/31/2021	SEEMA SINGH	FEMALE	23yrs	PAIN ON EATING HOT FOOD SINCE 1-2 DAYS	VAS=8	TIP OF TONGUE
8	15225	8/4/2021	SAMA	FEMALE	30yrs	PAIN IN LEFT SIDE OF CHEEK SINCE 2 DAYS	VAS=7	LEFT BUCCAL MUCOSA
9	10915	9/8/2021	SUNIL	MALE	32yrs	PAIN IN LOWER LIPS SINCE 1-2 DAYS	VAS=8	LOWER LABIAL MUCOSA
10	11602	9/15/2021	GULSHAN	FEMALE	28yrs	PAIN IN UPPER FRONT REGION SINCE 1-2 DAYS	VAS=6	UPPER LABIAL MUCOSA
11	8990	10/1/2021	SARAVJEET	MALE	27yrs	PAIN IN LOWER LIPS SINCE 1-2 DAYS	VAS=8	LOWER LABIAL MUCOSA
12	10830	11/12/2021	RAJEEV	MALE	21yrs	PAIN IN RIGHT SIDE OF CHEEK SINCE 2 DAYS	VAS=8	RIGHT BUCCAL MUCOSA
13	17351	11/23/2021	SWATI PANDEY	FEMALE	24yrs	PAIN IN LEFT SIDE OF CHEEK SINCE 2 DAYS	VAS=7	LEFT BUCCAL MUCOSA
14	11761	12/17/2021	SARITA MISHRA	FEMALE	29yrs	PAIN IN LOWER LIPS SINCE 1-2 DAYS	VAS=9	LOWER LABIAL MUCOSA
15	13795	1/6/2022	TABASSUM BANO	FEMALE	27yrs	PAIN IN RIGHT SIDE OF CHEEK SINCE 2 DAYS	VAS=8	RIGHT BUCCAL MUCOSA

CLINICAL EVALUATION (BASE LINE VISIT)	(BEFORE LA	ACTIVE PHASE (AFTER LASER)	st VISIT (BEFORE LASER THERAP	SIT (AFTER LA	2nd VISIT	FOLLOW UP
SINGLE ULCER, 0.4X0.4cm D, CIRCULAR IN SHAPE	VAS=7	VAS=4, size 0.4X0.4cm D	VAS=3, size 0.4X0.4cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.5X0.5cm D, CIRCULAR	VAS=9	VAS=5, size 0.4X0.4cm D	VAS=4, size 0.4X0.4cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.5X0.7cm D, OVAL IN SHAPE	VAS=9	VAS=6, 0.4X0.6cm D	VAS=5, size 0.4X0.6cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.3X0.4cm D, OVAL IN SHAPE	VAS=8	VAS=4, size 0.2X0.4cm D	VAS=3, size 0.2X0.4cm D	VAS=0	VAS=0	VAS=0
DOUBLE ULCER, 0.6X0.7cm &0.3X0.3cm D, OVAL & CIRCULAR IN SHAPE	VAS=8	VAS=5, size 0.4X0.5cm D	VAS=4, size 0.4X0.5cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 06.X0.7cm D, OVAL IN SHAPE	VAS=8	VAS=5,size 0.4X0.4cm D	VAS=6, size 0.4X0.4cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.7X0.8cm D, OVAL IN SHAPE	VAS=8	VAS=4,size 0.6X0.6cm D	VAS=3, size 0.6X0.6cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.5X0.6cm D, OVAL IN SHAPE	VAS=7	VAS=4, size 0.4X0.4cm D	VAS=3, size 0.4X0.4cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.6X0.6cm D, CIRCULAR IN SHAPE	VAS=8	VAS=5, size 0.5X0.5cm D	VAS=5, size 0.5X0.5cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.6X0.7cm D, OVAL IN SHAPE	VAS=6	VAS=3, size 0.5X0.5cm D	VAS=4, size 0.5X0.5cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 05.X0.5cm D, CIRCULAR IN SHAPE	VAS=8	VAS=5, size 0.4X0.4cm D	VAS=4, size 0.4X0.4cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.5X0.5cm D, CIRCULAR	VAS=8	VAS=4, size 0.4X0.4cm D	VAS=5, size 0.4X0.4cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.5X0.7cm D, OVAL IN SHAPE	VAS=7	VAS=3, size 0.3X0.4cm D	VAS=4, size 0.3X0.4cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 06.X0.7cm D, OVAL IN SHAPE	VAS=9	VAS=6, size 0.4X0.6cm D	VAS=3, size 0.4X0.6cm D	VAS=0	VAS=0	VAS=0
SINGLE ULCER, 0.6X0.6cm D, CIRCULAR IN SHAPE	VAS=8	VAS=5, size 0.4X0.5cm D	VAS=4, size 0.4X0.5cm D	VAS=0	VAS=0	VAS=0

MASTER CHART - TRIAMCINOLONE ACETONIDE 0.1%

CASE NO.	OPD NO.	DATE	NAME	GENDER	AGE	HISTORY	BURNING SENTATION * VAS SCALE
1	11314	2/18/2021	TANJULA	FEMALE	26yrs	PAIN IN LOWER LIPS SINCE 1-2 DAYS	VAS=8
2	355	3/3/2021	GAURI MISHRA	FEMALE	32yrs	ULCERS IN LEFT SIDE OF CHEEK REGION SINCE 2-3 DAYS	VAS=7
3	17359	3/10/2021	ARJUN SINGH	MALE	31yrs	ULCER ON TONGUE SINCE 2 DAYS	VAS=7
4	11759	7/15/2021	AJEET K. MISHRA	MALE	19yrs	ULCER ON TONGUE SINCE1- 2 DAYS	VAS=9
5	18279	7/22/2021	RAVINDRA KUMAR	MALE	21yrs	PAIN ON RIGHT SIDE OF CHEEK SINCE 2-3 DAYS	VAS=8
6	38245	8/12/2021	ARCHITA	FEMALE	20yrs	PAIN IN TONGUE SINCE 2-3 DAYS	VAS=7
7	13190	8/20/2021	SWAPNIL SHUKLA	MALE	21yrs	PAIN ON RIGHT SIDE OF CHEEK SINCE 2-3 DAYS	VAS=6
8	2794	9/7/2021	NIDHI PATEL	FEMALE	24yrs	PAIN IN TONGUE SINCE 2-3 DAYS	VAS=7
9	13795	9/22/2021	TABASSUM BANO	FEMALE	27yrs	PAIN IN UPPER LIPS SINCE 2-3 DAYS	VAS=8
10	16336	10/8/2021	ALOK KUMAR	MALE	25yrs	PAIN IN RIGHT SIDE OF CHEEK REGION SINCE 1-2 DAYS	VAS=7
11	12811	10/22/2021	ARPAN MALK	MALE	20yrs	PAIN IN UPPER BACK REGION SINCE 2-3 DAYS	VAS=8
12	3175	11/4/2021	RAVINDRA NISHAD	MALE	22yrs	PAIN ON RIGHT SIDE OF CHEEK SINCE 2-3 DAYS	VAS=6
13	1929	11/16/2021	SUNIL PAL	MALE	28yrs	PAIN ON LEFT SIDE OF CHEEK SINCE 1-2 DAYS	VAS=7
14	4201	12/18/2021	VAIBHAV PRATAP SINGH	MALE	18yrs	PAIN IN LOWER LIPS SINCE 1-2 DAYS	VAS=8
15	4595	1/5/2022	MOHD. ARIF	MALE	28yrs	PAIN ON RIGHT SIDE OF CHEEK SINCE 2-3 DAYS	VAS=6

SITE	CLINICAL EVALUATION (BASE LINE VISIT)	FOLLOW UP (1st) DAY 3	FOLLOW UP (2nd) DAY -7	FOLLOW UP
LOWER LABIAL MUCOSA	SINGLE ULCER, 05.X0.5cm D, CIRCULAR IN SHAPE	VAS=5, size 0.4X0.3cm D	VAS=2, size 0.5X0.5cm D	VAS=0
LEFT BUCCAL MUCOSA	DOUBLE ULCERS, 0.6X0.7cm & 0.3X0.3cm D, OVAL IN SHAPE	VAS=4, size 0.5X0.5cm and 0.2X0.3cm D	VAS=1, size 0.4X0.3cm D	VAS=0
TIP OF TONGUE	SINGLE ULCER, 05.X0.6cm D, OVAL IN SHAPE	VAS=2, size 0.4X0.5cm D	VAS=0, 0.1X0.1cm D	VAS=0
TIP OF TONGUE	SINGLE ULCER, 0.5X0.5cm D, CIRCULAR IN SHAPE	VAS=5, size 0.4X0.3cm D	VAS=3, 0.2X0.1cm D	VAS=0
RIGHT BUCCAL MUCOSA	SINGLE ULCER, 0.6X0.6cm D, CIRCULAR IN SHAPE	VAS=4, size 0.5X0.5cm D	VAS=1, size 0.3X0.3cm D	VAS=0
TIP OF TONGUE	SINGLE ULCER, 0.5X0.5cm D, CIRCULAR IN SHAPE	VAS=2, size 0.4X0.5cm D	VAS=0, 0.1X0.1cm D	VAS=0
RIGHT BUCCAL MUCOSA	SINGLE ULCER, 0.6X0.7cm D, OVAL IN SHAPE	VAS=2, size 0.5X0.5cm D	VAS=0, 0.1X0.1cm D	VAS=0
VENTRAL SURFACE OF TONGUE	SINGLE ULCER, 0.3X0.5cm D, OVAL IN SHAPE	VAS=4, size 0.2X0.4cm D	VAS=1, 0.1X0.1cm D	VAS=0
UPPER LABIAL MUCOSA	SINGLE ULCER, 0.6X0.7cm D, OVAL IN SHAPE	VAS=4, size 0.5X0.5cm D	VAS=1, 0.2X0.3cm D	VAS=0
RIGHT BUCCAL MUCOSA	SINGLE ULCER, 0.5X0.5cm D, CIRCULAR IN SHAPE	VAS=3, size 0.4X0.5cm D	VAS=0, 0.1X0.1cm D	VAS=0
UVULA	SINGLE ULCER, 0.5X0.5cm D, CIRCULAR IN SHAPE	VAS=3, size 0.4X0.5cm D	VAS=1, 0.1X0.2cm D	VAS=0
RIGHT BUCCAL MUCOSA	SINGLE ULCER, 0.5X0.5cm D, CIRCULAR IN SHAPE	VAS=3, size 0.4X0.5cm D	VAS=0, 0.1X0.1cm D	VAS=0
LEFT BUCCAL MUCOSA	SINGLE ULCER, 0.5X0.5cm D, CIRCULAR IN SHAPE	VAS=4, size 0.3X0.4cm D	VAS=1, 0.2X0.2cm D	VAS=0
LOWER LABIAL MUCOSA	SINGLE ULCER, 0.6X0.6cm D, CIRCULAR IN SHAPE	VAS=4, size 0.5X0.5cm D	VAS=1, 0.1X0.3cm D	VAS=0
RIGHT BUCCAL MUCOSA	SINGLE ULCER, 0.5X0.5cm D, CIRCULAR IN SHAPE	VAS=2, size 0.3X0.3cm D	VAS=0, 0.1X0.1cm D	VAS=0