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Narrative Review on Role of *Streptococcus mutans* in Dental Caries and Homoeopathic Intervention.

Narrative Review on Role of Streptococcus mutans in Dental Caries and Homoeopathic Intervention.

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ABSTRACT

This study is to report on *Streptococcus mutans*, which is one of the important bacteria that cause dental caries. The prevalence of dental caries is very high and varied across India. Dental caries is a major public health problem, an urgent need of oral health educational programs. *S. mutans* play a central role in plaque formation. Its virulence factor can form a biofilm known as dental plaque on tooth surfaces. *S. mutans* is a gram-positive coccus; intake of easily fermentable carbohydrates (usually sucrose) stimulates oral bacterial growth. *S. mutans* Pathophysiology of dental decay focused on dynamic pH phenomena that occur between the plague and enamel surface. The review study is based on the review article and preclinical studies; *in vitro* studies, *in vivo*, clinical trials are documented that antibacterial medicines are used as an antibacterial agent against *S. mutans*. *Calcarea phosphorica* is one of the frequently prescribed Homoeopathic medicines for dental disease. The use of Homoeopathic intervention is elaborated in the present review. Databases, such as PubMed, Cochrane, Wiley, Google Scholar, ResearchGate, DOAJ were searched and relevant articles were used for reviewing purposes. Based on the results, we recognised that further research is needed to prevent and treat dental caries with oral hygiene awareness.

Keywords*:* Streptococcus mutans, Dental caries, Homoeopathy, Homoeopathy.

RESUMEN

Este estudio es para informar sobre Streptococcus mutans, que es una de las bacterias importantes que causan la caries dental. La prevalencia de la caries dental es muy alta y variada en la India. La caries dental es un importante problema de salud pública, una necesidad urgente de los programas educativos de salud bucal. S. mutans juega un papel central en la formación de placas. Su factor de virulencia puede formar una biopelícula conocida como placa dental en la superficie de los dientes. S. mutans es un coco grampositivo; la ingesta de carbohidratos fácilmente fermentables (generalmente sacarosa) estimula el crecimiento bacteriano oral. S. mutans Fisiopatología de la caries dental centrada en los fenómenos de pH dinámico que se producen entre la placa y la superficie del esmalte. El estudio de revisión se basa en el artículo de revisión y estudios preclínicos; Los estudios in vitro, in vivo, los ensayos clínicos están documentados de que los medicamentos antibacterianos se utilizan como agente antibacteriano contra S. mutans. Calcarea phosphorica es una de las medicinas homeopáticas frecuentemente prescritas para las enfermedades dentales. El uso de la intervención homeopática se elabora en la presente revisión. Se realizaron búsquedas en bases de datos, como PubMed, Cochrane, Wiley, Google Scholar, ResearchGate, DOAJ y se utilizaron artículos relevantes para fines de revisión. Con base en los resultados, reconocemos que se necesita más investigación para prevenir y tratar la caries dental con conciencia sobre la higiene bucal.

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Palabras clave: Streptococcus mutans, Caries dental, Homeopatía, Homeopatía.

INTRODUCTION

Dental caries is one of the most prevalent chronic diseases affecting individuals all over the world. Society is more prone to tooth pain and tooth loss throughout their lifetime(Selwitz RH et al.,2007). The aim of this study is to see the antimicrobial activity of Homoeopathic medicines in dental caries caused by *S. mutans* along with its prevalence, virulence properties. To study the anti-microbial activity of Homoeopathic Medicines with the method of agar well diffusion and minimum inhibitory concentration methods will be used. This review also includes exploring the studies done in the area of dental caries caused by *S. mutans* with various medications like herbal, antibacterial and its adverse event and the effectiveness of the AYUSH system in dental caries was also highlighted. According to the WHO index in India, prevalence studies revealed that dental caries in the age group of 5–12-year was quite similar (49%) and the ratio raised at 15 year age which affected 60%, the highest percentage (80%) at 65–74-year age group and 2011 study was stated that about 79.4million children at the age of 0-6 were affected by Early Childhood Caries (ECC).[Janakiram C, et al] Among the available data, many countries reported a marked increase in dental caries that affects children and adults' quality of life. An urgent need for oral health education can lead to preventing these(Bagramian RA et al.,2009). In rural communities of India, oral hygiene is the foremost unconsidered aspect of health; the necessity for oral health awareness, and affordable oral health services to be provided in rural communities (Salunke S et al.,2019). In 1924 Clarke, isolated a bacterial species from carious lesions that seemed like a mutant sort of a coccus, then he introduced it as *Streptococcus mutans* a sugar-fermenting acidogenic microbe that has been considered the primary etiology of dental caries(Simón-Soro A et al., 2015, Banas JA 2004) Now, the control of the cavity depends on the severity, medicated by antibacterial and surgeries that have side effects and drug resistance and need for alternative and effective therapies against *S. mutans*(Cui T et al.,2019). Homoeopathy is one of the medical systems which is known for its safe and effective treatment for curing. Various Homoeopathic remedies are Aconite, Hypericum, Belladona, Ledum pal. Chamomilla, Plantago, Ruta, Arsenic album, Ferrum phos. etc., used in Dental conditions like Nerve pain, toothache with abscess, tooth cavity, local Anaesthesia Antidote, Orthodontic treatment, teething problem, post cavity filling, oral ulcer, Toothache, severe gingivitis. These remedies are prepared by a process of repeated dilution and shaking called Potentisation which is capable of stimulating the process of healing based on some principle and is able for the person fighting against the disease (Sinha Net al.,2015].

MATERIAL AND METHODS

Data synthesis: The extensive literature review was done from various available previous work (preclinical, review, antimicrobial (*in vitro, in vivo*) done on the subject under study.

Selection of Databases: PubMed, Cochrane, Wiley, Google Scholar, ResearchGate, DOAJ were searched, and relevant articles were used for reviewing purposes.

Selection of Keywords: Homeopathy, Homoeopathy. *Streptococcus mutans,* Dental caries*,* Tooth decay, Dentistry, *In vitro, in vivo,* Meta-analysis, Review, Clinical studies, Cases, Trial.

Dental caries: Dental caries is a chronic infectious disease produced by oral microbes depending upon caries causing factors of age, diet, malnutrition, gastroesophageal reflux disease, worn fillings social and environmental, genetic, and immunological responses. Dental caries is of two types: Primary caries (lesion that appears below the Contact area between teeth and on the occlusal surface is also a localized occurrence. Secondary caries (lesion located at the edge of a dental restoration with an indication of demineralization against the cavity wall (Yadav K et al.,2017).

Symptoms of dental caries with Stages:

1st stage: Calcium loss indicates discoloration (yellowish spots), reversible with no pain.

2nd stage: Decaying of enamel leads to damage that is irreversible without pain.

3rd stage: Dental carries proceed to dentine, with pain.

4th stage: Action of bacteria leads to pus formation causes pain.

5th stage: Infection progressed to the root tip of the tooth involved bone causing severe toothache and swelling (Yadav K et al.,2017).

Oral microorganism for dental caries

The most prevalent agents of enamel caries are two kinds of *mutans streptococci, Streptococcus mutans and Streptococcus sobrinus.* Caries is also caused by *Lactobacillus* and *Actinomyces*. *Actinomyces odontolyticus* is a fungus that caused tooth decay (colonizes infants before the eruption of teeth). *Actinomyces naeslundii*, *A. israelii*, and *A. gerencseriae* are responsible for some root caries lesions. *Streptococcus mitis*, *Bifidobacterium*, and *Actinomyces* (a collection of 'low pH' aciduric isolated from white spot lesions in people) are other important species involved in caries. In contrast to bacteria that lower plaque pH including *Veillonella* and *Actinomyces* causes caries(Yadav K et al.,2017).The main fungal species verified which are belonged to the genera *Aspergillus spp., Fusarium spp., Candida spp., and Rhodotorula spp.* (*Fusarium spp.* did not form biofilms). As for yeasts, all the *Candida spp*. isolates grew as a biofilm. There are very few studies on the fungal contamination of water in dental units and the possible formation of biofilms (Damasceno JL et al.,2017).

About *Streptococcus mutans*

Gram-positive coccus non-motile, non-spore forming, catalase-negative, facultative anaerobic cocci bacterium commonly found in the human oral cavity, is a significant contributor to tooth decay *S. mutans.* (ElSherbinyGM et al.,2014). The bacterial action of *S. mutans* metabolises different sugars and glycosides, including glucose, fructose, sucrose, lactose, galactose, mannose, cellobiose, glucosides, trehalose, maltose, and a group of sugar alcohols (Yadav K etal.,2016). The tendency of *S. mutans* to use sucrose to produce adhesion and accumulation, acidogenicity, acid tolerance, and increased host-microbe interaction is the primary virulence properties of the dental bacteria. Such traits only increase the pathogenicity of the organism (Banas JA, et al.,2004, Cui T et al.,2019, ElSherbiny GM etal.,2014, Matsumoto-Nakano M et al.,2018). In the presence of sucrose, acidogenic *S. mutans* will produce extracellular polysaccharides (EPS). The ability of *S. mutans* to produce significant amounts of EPS from sucrose is a major element in its cariogenicity (Forssten SD, et al2010).

Various studies on *S. mutans* related to dental caries

Agarwal P et al, in 2010, Study aimed to evaluate the antimicrobial activity of the tulsi (*Ocimum sanctum)* extract against *Streptococcus mutans* and to determine which concentration of Tulsi *(Ocimum sanctum)* extract among the 15 concentrations had the maximum antimicrobial activity on *S. mutans*. The author was used ethanolic tulsi extract prepared by the cold extraction method, Brain heart infusion agar as a medium, 0.2% chlorhexidine was used as a positive control, and dimethylformamide was used as a negative control. The extract, along with the controls, was transferred to the respective agar plates and these were incubated aerobically at 37°C for 48 h. The inhibition zones were measured using a vernier caliper. The result indicated that the composition of Tulsi extract at 4% may have the highest antimicrobial activity against *S. mutans* (Agarwal P et al.,2010). *Jiang X et al, in 2016,* study aimed to find out the antibacterial activity of Bauhinia championii (Benth) extract against *S. mutans.* A two-fold agar dilution method was used. This study found that minimal inhibitory concentration was 12.5 mg/mL and there has a significant inhibitory activity of adherence and acidogenicity against *S. mutans, when* the Bauhinia championii concentration was greater than or adequate to 3.13 mg/ml. The extract of Bauhinia championii (Benth.) was found to strongly inhibit the expansion of *Streptococcus Mutans* in this experiment (Jiang X et al.,2016). *Naderi NJ et al, in 2011,* This study was to determine the bactericidal activity of non-fermented and semi-fermented tea (Iranian green and black tea) extract at different concentrations (50mg/ml, 100mg/ml, 200mg/ml, 300mg/ml and 400 mg/ml), which were tested by using the well assay method. The method of agar dilution was used, MIC was determined the lowest concentration of extract inhibiting visible growth of the bacteria on the agar media plate, the minimum inhibitory concentration of green and black tea was150 and 50 mg/ml and the zone of inhibition for a methanolic extract of green and black tea was 9.5 mm and 10.9 mm. Respectively, Green tea's activity appears to be higher in concentration than black tea's(Naderi NJ et al.,2011), *Chaudhary NJ et al, in 2012,* This study was carried out to evaluate the efficacy of 3 different concentrations (5%,10%,50%) Pudina extract against *Streptococcus mutans, Chlorhexidine* (0.2%) and Dimethylformamide was used as a positive and negative control. *Streptococcus mutans* were incubated at

37^0 for 24 hours and lastly, it was inoculated on the blood agar plate. Chlorhexidine was shown to be more effective than Pudina and concluded that the Pudina extract had antimicrobial activity against *S. mutans* (Chaudhary NJ et al.,2012). *Hosseini F et al, in 2013,* the study aim was to evaluate the antimicrobial activities of diethyl ether mastic gum extract of *Pistacia atlantic* against *S. mutans* biofilm. Methods used for this study Mueller Hinton agar, disc diffusion method, plant material, and extract, bacterial viability blood agar was used, chromatographic analysis done by GCMS to determine antibacterial activity and identified that the diethyl ether extract of *P. atlantica* killed 98% of the cell of *S. mutans* (Hosseini F et al.,2013). *Al-Bazaz FA et al, in 2018,* this study aimed to evaluate the antibacterial activity of different concentrations of hydroxyapatite and iron oxide nanoparticles ionized water(a negative control), by the methods of agar well technique, a zone of inhibitions of the bacteria was measured across the diameter, suspension solutions, in comparison to 0.2% chlorhexidine (a positive control)against *S.mutans* and concluded that *Streptococcus mutans* showed the complete resistance for the hydroxyapatite nanoparticles, while iron oxide nanoparticles, highly sensitive to *Streptococcus mutans*, indicate an antibacterial activity of iron oxide nanoparticles (Al-Bazaz FA et al.,2018). *Zonuz AT et al, in 2008, the* objective was to identify the role of cigarette smoke on the *Streptococcus mutans* and *Streptococcus sanguis* growth, highlighted smoking factor and its impact on oral cavity microbial ecosystem, standard strains collected of *S. mutans* (ATCC 25175) and *S. sanguis* (ATCC 10556) and cultured on blood agar, incubated for 48 hr in three main environments and diameter of colonies was measured. Observation showed that the cigarette smoke and carbon dioxide environments were highly responsible for the growth of *S. mutans*. Various studies have confirmed the effect of tobacco use on different organs and increased the growth of cariogenic bacteria. (Zonuz AT et al.,2008). *Prabhakar J et al, in 2014,* the aim was to determine the antimicrobial efficacy of Triphala &0.2 chlorhexidine against *S.mutans* biofilm with the culture of *S.mutans* were grown on brain heart infusion agar, for an antibacterial susceptibility test performed with a disc diffusion method and this study results determined Triphala herbal took 6min, on 3 and 7 days Triphala herbal formation showed maximum antibacterial sensitivity on *S.mutans* biofilm comparatively 0.2% chlorhexidine was found ineffective on a 7day against a biofilm (*Prabhakar J et al*.,2014). *Hasan S et al, in 2015,* this study aimed to evaluate the effect of crude extract and a methanolic fraction of *Z. officinale* against *S. mutans* virulence properties. Results of this study were, investigated in vitro and in vivo, the activity of crude extract and methanolic fraction at sub- MIC levels on cariogenic properties of *S. mutans* extracts strongly inhibited a selection of virulence properties of *S. mutans* which are critical for its pathogenesis, the result found that the glycolytic pH drop showed inhibitory activity of the extracts against acidogenicity, marked by an unbelievable reduction within the initial and final rate of the ph (Hasan S et al., 2015). *Banavar Ravi S et al, in 2017,* Study was focused to determine the antimicrobial activity of garlic bulbs, pudina leaves, and mango and eucalyptus twig extract against *Streptococcus mutans* by finding their zone of inhibition and their minimum inhibitory concentration (MIC). Two tests were carried out for this study, first to evaluate the antimicrobial activity by measuring the zone of inhibition by well diffusion method and minimum inhibitory concentration (MIC) as per the NCCLS method. Results of this study showed that the tested compounds *Mangifera indica* and *Eucalyptus* have the highest antibacterial activity at minimum concentration can be incorporated in oral rinses, as dentifrices, cavity liners, and are able to improve oral hygiene (Banavar Ravi S et al.,2017). *Patidar RK et al, in 2012,* a study was to determine the biofilm formation and antibacterial sensitivity against S. mutans by the method of the microtiter plate assay, coverslip assay and disc diffusion method. The finding of this study revealed that 92% of 100 clinical isolates had strong biofilm-forming potential, while 8% had moderate biofilm-forming capacity. The outcome of the study showed that resistance to amoxicillin was 72%, chloramphenicol was 65%, doxycycline was 40%, erythromycin was 46%, ofloxacin was32%, and tetracycline was 61%. Concluded that the combined treatment is more efficient against cariogenic *S. mutans* (Patidar RK et al.,2012).

Treatment of dental caries in different medical streams

Allopathic treatment in dental caries

Treatment of dental caries depends on the severity of dental caries and according to the pathogenesis and focused to prevent the dental structures and further deterioration of tooth.

Medication, Antimicrobial mouth rinse-help in the management of bacterial growth. Dental sealants (minimize the chances of dental caries), antiseptic chip (to reduce the size of periodontal pockets), antibiotic gel, oral antibiotics, Dental filling- Method that restores the function, integrity, and morphology of lost tooth structure using dental restorative material (such as dental amalgam, composite resin, porcelain, and gold). Teeth removal - Procedure for removing dental caries by tooth extraction (Yadav K et al.,2016).

Calcium and Fluoride treatments have frequently been suggested for preventing dental cavities and protecting from tooth decay. For prevention of teeth decay included (Oral hygiene, regular examination of teeth, awareness about oral health, brushing of teeth, and diet maintenance) (Yadav K et al.,2016). Allopathic medicine has efficacy in the treatment of dental complaints caused by various microorganisms like bacteria and fungi. Literature showed that treating dental caries with allopathic medicines has more side effects that are hazardous to the patients as mentioned in the studies. (Kaur SP et al.,2011)

Ayurveda treatment in dental caries

Ayurvedic medicine is effective in the treatment of tooth problems caused by bacteria and fungi. Literature showed that ayurvedic medications have antibacterial efficacy against dental cavities caused by bacteria. Ajowan (reduce the cariogenic factor of *S.mutans)*, Aloe vera (prevention of dental caries), Clove (help in plaque-inducing properties), Green tea (prevention the adhesion of *S.mutans*), Haritaki (use as an anti-bacterial treatment), Honey(aphthous ulcers, candidiasis, gingivitis), Liquorice: mouthwash, toothpaste, gel for periodontal disease, denture stomatitis, gingivitis, dental caries), Mango (periodontitis), Neem (mouth rinse for dental plaque, periodontal disease), Pomegranate (both bacteria and fungi)(Gupta R et al.,2015).

Unani medicine in oral health

The origin of drugs is natural and is widely used in folk medicine and traditional systems of medicine for oral and dental problems around the world. Many Unani medicines have shown to be an effective treatment on oro-dental diseases, with various remedies having multi-dimensional properties such as analgesic, anti-inflammatory, anti-microbial, anti-ulcer activities, sources of these medicines may be derived from, animal, or mineral sources, with plant origin drugs being the most commonly used in the Unani system of medicine.
Name some Unani drugs indicated in dental diseases: *Filfil Siyah, Mizaj, Gul e Surkh, Heel e khurd* (Cardamom), *Gulnar, Acacia catechu Willd. (Mimosaceae), Kafoor, Kababa Khandan, Neem (Azadirachta indica A. Juss), Miswak (Peelu), Podeena, Qaranfal (Laung), Sandroos (Trachylobium hornnemannianum Hayne.), Sumbul-ul-teeb (Nardostachys jatamansi DC), Aqaqia (Babool)* (RaiA et al.,2020).

Brief Introduction of Homoeopathy

German physician Samuel Hahnemann founded Homoeopathy as a mode of healing in the late 18th century. He made remedies from a large number of natural ingredients during his trials. Homoeopathy is a medical system derived from animal, mineral, and plant sources (Yalgi VS et al.,2019). Based on the principle of "like heals like", Homoeopathy is a medical system of treatment that has been practiced for over 200 years. Although the medicines administered low and ultra-molecular dilutions, clinical experience and data indicate that they are effective (Eames S et al., 2011). The Approach of treatment of disease caused by substances by administering similar substances in an extremely diluted form that has no negative effect on the body. (Sanadhya YK et al.,2013). Homoeopathy is a rapidly growing system; half has been practiced in India for quite a century. A holistic approach towards the sick is taken to balance individual inner balance at mental, emotional, spiritual, and physical levels. The strength of Homoeopathic medicine lies in its evident effectiveness. (Sanadhya YK et al.,2013, Hoseinishad M et al.,2015). Briefly, Homoeopathy is one of the healing systems that deal with the sick to cure illness, based on certain principles of healing “Similia Similibus Curentur’’. Homoeopathy features a holistic view of health and believes that each disease has basic causes that the Homoeopathic remedies specialize in them (Sanadhya YK et al, Hoseinishad M et al.,2015).

Advantages of Homoeopathy

Recovery chances for some chronic/incurable conditions, some chronic or acute conditions, which do not have a definite conventional medical treatment can be managed by Homoeopathy in various conditions. Homoeopathic medications are available in four forms: tablets, globules (wetted with Homoeopathic dilutions), ointment (effective for the treatment of topical and cutaneous conditions), alcoholic solution (medication was

soluble in; water and ethyl alcohol combination, with various proportions; the percentage of alcohol is generally <40%). Homoeopathic prescriptions combination of pathological, constitutional, or both. Constitutional prescription is aimed at the analysis of the patient's, temperament, body type, and behaviour while pathological prescriptions are based to cure a specific disease (Kardanpour G et al.,2016).

Homoeopathy in Dentistry

Homoeopathic medicines have been used in everyday practice as a treatment from acute to chronic pathology in dental conditions: for example – toothache, burning mouth, dental delay, post-operative condition dental anxiety, dental abscess, diseases related to gingiva and periodontium, bleeding, bleeding following dental surgeries, delayed tooth eruption, oral ulcerations, oral herpetic lesions, teething (Sanadhya YK et al.,2013).It is also suitable for those conditions, where conventional medicine falls short. In dentistry, Homoeopathic prescriptions are related to a combination of constitutional and pathological prescriptions (Sanadhya YK et al.,2013, Hoseinishad M et al.,2015, Kardanpour G et al.,2016). Homeopathy cannot replace the mechanical parts of dentistry but can be used in addition to conventional treatments and have various ways that can be included in the dental practice either as a substitute for conventional medications (Eames S et al., 2011, Sanadhya YK et al.,2013).

Some drugs found as therapeutic agents for oral health

Aranea diadema, Belladonna, Calcarea carbonica, Coffea cruda, Ferrum metallicum, Magnesia carbonica, Magnesia phosphorica, Plantago major, Pulsatilla, Staphysagria, Phosphorus, Calcarea fluoricum, Calcarea phosphorica, Borax, Chamomilla. Natrum muriaticum, Nitircum acidum, Calendula mouthwash, *Kreosotum*, *Bacillinum*, *Hydrastis canadensis, Lachesis, Pyrus americana, Myristica sebifera. Kali chloricum, Mercurius* solubilis (Ulceration of teeth) (Hoseinishad M et al.,2015). *Arsenicum album*, *Ferrum phosphoricum, Nux vomica* (pain, gums that bleed after brushing), *Hypericum*(tender gum tissue and to promote healing), *Natrum muriaticum* (maintenance of the Tissue integrity), *Hepar sulphuris* (Used for tissue with suppuration, chronic abscesses), *Silicea (*Periodontal abscess with swollen glands, *Staphysagria* (Loose teeth, pain worse by pressure), *Symphytum*(Injuries to the periosteum, stimulates the growth of epithelium on ulcerated surfaces), *Phosphorous* (swollen gums that bleed easily and in cases of hyper-salivation), *Aranea diadema* (injured bone and alveolitis) were used for acute and chronic dental problem and result were found effective (Sanadhya YK et al.,2013 , Steinlechner F et al.,1984).

Homoeopathic studies related to dental caries

Homoeopathic medicine has efficacy in the treatment of dental complaints caused by various microorganisms like bacteria and fungi. Works of the literature have shown that Homoeopathic medicines have antibacterial activity against the dental caries infections caused by bacteria, as presented in the following studies: *Yalgi, et al, in 2019,* Homoeopathic medicines (Hypericum perforatum, Arnica Montana, Echinacea angustifolia, and Calendula officinalis) was taken to evaluate the antibacterial activity against two strain *Streptococcus mutans* and Enterococcus *faecalis* using disc diffusion testing, blood agar, and brain heart infusion agar and 9 dilutions of each medicine. Maximum zone of inhibition was observed with Hypericum perforatum against *S. mutans* and *E. faecalis* the highest inhibition was seen with *Echinacea angustifolia*, for Arnica Montana showed good antibacterial activity on *S. mutans* and *E. faecalis* whereas, with Calendula officinalis lower inhibitory activity was seen against *E. faecalis* but no activity against *S. mutans* (Yalgi VS et al.,2019). *Mehta S et al, in2013,* the aim of the study was to match the efficacy of obtainable homoeopathic mouthwash with chlorhexidine on plaque status, gingival status, and salivary *Streptococcus mutans*. The study was double-blind, administered to 55 healthy children between the age of 8 &14 years which were divided into two groups. Homoeopathic mouth wash (Freshol- mixing of Staphysagria 3x, chamomilla3x, Echinacea 3x, plantago3x, ocimum 3x, cistus 3x in distilled water) was given to A, and B was given chlorhexidine served as an impression. The author had done a clinical trial on A 35 & group B 20 (chlorhexidine), divided into three phases. During this study, the period of the 1&3 phase was the same but 2 phase was for 3 weeks. The result of the study was that Freshol had found better results than chlorhexidine and suggests that Freshol helps to improve oral health (Mehta S.et al.,2013). *Bansal K et al, in 2014,* this study amid to evaluate the efficacy of Calcarea fluorica on artificial carious lesions by Scanning

electron microscope (SEM) and Surface microhardness (SMH). Patients in the group1 received no tablets, while in group 2 patients received Calc -f tablets (4tablets twice a day) SEM revealed remineralization in both groups, as well as an increase in surface hardness values in both groups. The Saliva showed a tendency of remineralizing the early carious lesions, as seen by SEM, and an increase in Vickers microhardness number (VHN) in the control group. The study concluded that Calc-f tablets were shown to be a safe and cost-effective remineralizing agent (Bansal K et al.,2014). *Shivashankar et al, in 2020,* Toothpaste formulations containing homoeopathic and natural antimicrobial agents were more effective in controlling the oral microflora compared to toothpaste containing synthetic antimicrobial agents like triclosan. Three strains of microorganisms, *Streptococcus Mutans, Escherichia Coli, and Candida Albicans* (Kengadaran S et al.,2020). *RT Mathie et al in 2007,* Background of the study targeted research development in Homoeopathic dentistry. The multi-practitioner piolet study was conducted over a 6-month period in which 14 homoeopathic dentists collected clinical data and outcome data. Found that the conditions like pericoronitis, periodontal (abscess, infection), reversible pulpitis, sensitive cementum, and dental caries with toothache were frequently treated. The outcome of this clinical study was positive and concluded that recording data in Homoeopathic dentistry was useful for further research (Mathie RT et al.,2007). *Anushree B et al, in 2015, In vitro* study aimed to determine the antibacterial activity of different kinds of toothpaste against oral pathogen Escherichia *coli* (ATCC25922), *Staphylococcus aureus* (ATCC 25923), *Streptococcus mutans* (ATCC 0266P) and C*andida albicans* (Laboratory Strain) by the method of agar well diffusion. Results were obtained that all three herbal formulations (containing Neem, Pudina, Long, Babool, Turmeric and Vajradanti) showed substantial antibacterial effectivity. Homoeopathic toothpaste (combination of kreosotum, Plantago major and calendula) was indicated antimicrobial effectivity against *S. mutans* (Anushree B et al.,2015).

RESULTS

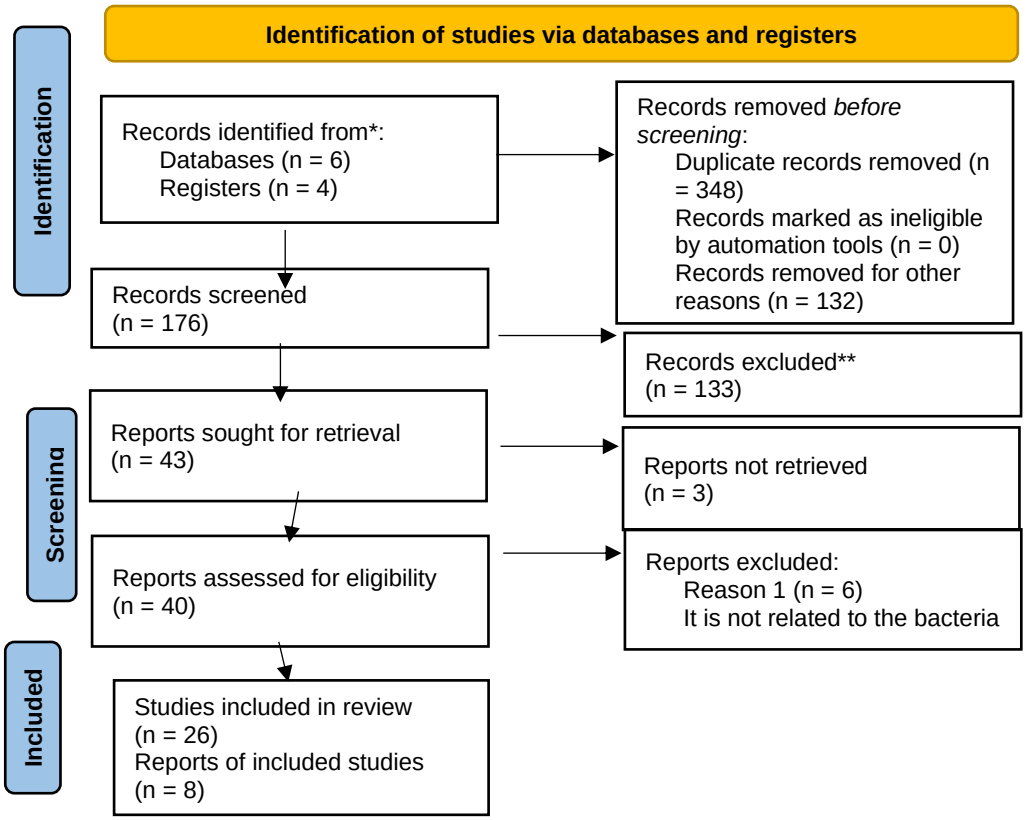

Fig 1. Flow chart showing studies included in the review

For this study 6 Databases used Duplicates records are removed and Record screened 176, Excluded 133 reasons for not related to this study and 43 article included but some study is not related to the bacteria and condition of dental caries, 26 studies and 8 reports are selected for this article.

DISCUSSION

Dental caries is one of the most common chronic diseases affecting individuals and also their lifestyles globally. After reviewing the article found that Homeopathy is one of the important systems which provides beneficial treatment for dental caries in clinical practice. It is helpful for those who are not responding to conventional treatment cases and patients undertaking dental treatment. In Homoeopathy there are few experimental studies (in vitro, in vivo) done in the field of dental caries. For this study PubMed, Cochrane, Wiley, Google Scholar, ResearchGate, DOAJ were searched and related articles were used for reviewing purposes. This review article includes briefly about the various system of the AYUSH for the effectiveness of the treatment of dental problems. As a narrative review, it includes studies that are related to bacteria (*Streptococcus mutans)* and focuses on Homoeopathic treatment in the field of dental caries.

We conclude that treatment for dental caries in conventional systems; antibacterial drugs mixed with steroids will have side effects on patients who were already suffering from infections. Whereas treatment of Homoeopathy and AYUSH have very minimal or no side effects, giving permanent relief to the patient. More studies (*in vitro, in vivo,* clinical trial) are required in Homoeopathic dentistry. In the future, we can plan to make a new combination of Homoeopathic medicine (toothpaste, mouth Wash) for the prevention of dental caries. Studies have shown that Homoeopathic treatment for dental problems has been associated with a significant cost reduction and harmless reduction.

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