



Clinical and Microbiological Evaluation of Caries Removal Using Brix 3000 Gel, Polymer Bur and Laser Technique in Primary Molars: An *In Vivo* Study

Jaya AR¹, Kalyani M Choudhar^{2*} and Vinaychandra R³

¹Reader, Department of Pedodontics and Preventive Dentistry, Rajarajeswari Dental College and Hospital Bengaluru, Karnataka, India

²II Year Post Graduate Student, Department of Pedodontics and Preventive Dentistry, Rajarajeswari Dental College and Hospital, Bengaluru, Karnataka, India

³Professor, Department of Conservative Dentistry and Endodontics, Rajarajeswari Dental College and Hospital, Bengaluru, Karnataka, India

***Corresponding Author:** Kalyani M Choudhar, II Year Post Graduate Student, Department of Pedodontics and Preventive Dentistry, Rajarajeswari Dental College and Hospital, Bengaluru, Karnataka, India.

Received: August 31, 2020

Published: September 26, 2020

© All rights are reserved by **Kalyani M Choudhar, et al.**

Abstract

Background: Newer techniques of Brix 3000 gel, Polymer bur and laser irradiation of dentinal caries removal are minimally invasive methods and should be more frequently employed in Pediatric Dentistry. To evaluate three different techniques of caries excavation in primary teeth in terms of efficacy, efficiency, fear and anxiety experienced during the procedure.

Materials and Methods: Sample of 30 children aged 5 to 9 years were equally divided into 3 groups –Brix 3000 Gel group (Group 1), Polymer bur group (Group 2), Laser group (Group 3).

Microbiological investigation was used to determine efficacy. Time was recorded to determine efficiency and Wong-Baker Faces Pain Scale (WBFPS) was used to assess the pain experienced.

Results: Data obtained were subjected to statistical analysis. Intergroup comparison for Wong Baker Faces Pain Scale (WBFPS) scores and time needed for caries excavation was done using Kruskal Wallis Test. Time required was tested using One-way ANOVA test and the results obtained were statistically significant.

Conclusion: Polymer bur method was more efficient whereas laser and Brix 3000 gel methods were more comfortable.

Keywords: Dental Caries, Primary Molars, Chemomechanical Caries Removal, Polymer Bur; Er:Cr:YSGG Laser

Introduction

Dental caries is one of the most prevalent infectious and transmissible disease with multifactorial etiology characterized by demineralization of hard tissues and destruction of organic substance of the tooth resulting in cavitation. Its manifestations do persist throughout life even after the lesion is treated. For several decades, dentists have been using conventional mechanical cutting and drilling systems for caries removal and cavity preparation

with the help of Tungsten Carbide, diamond or round steel burs. However, limitations of this technique involves overpreparation of cavities, sensitivity, pain and possible damage to pulp tissue due to elevated temperature and pressure on the pulp [1]. Fear and anxiety associated with noise produced from motor instruments and the need for anesthesia have also shown to induce psychological trauma in both parents and children making them either to avoid or postpone dental treatment in-turn resulting in need for more invasive procedures.

To overcome such limitations especially in children, the concept of minimal invasive dentistry (“prevention of extension”) was introduced and has gained popularity with technological improvements in cutting tools for tooth preparation and with development of new adhesive systems. Alternative methods such as atraumatic restorations, air abrasion, sono-abrasion and lasers, chemomechanical method, polymer burs, air polishing, ultrasonic, ozone method and enzymes have been suggested for cavity preparation [2].

Moreover, minimally invasive cavity preparations conserve tooth structure and the application of adhesive dental materials minimizes requirement for retention and resistance form as the preservation of original tissue is known to enhance prognosis of the tooth. Concept of Painless dentistry has shown to provide relief, comfort and solace to the child patient thereby instilling positive attitude towards dental treatment [3].

Various *in vivo* and *in vitro* studies have been conducted to compare the efficacy of Chemomechanical caries removal (CMCR) agents and Polymer bur with that of conventional caries removal methods. However, there is limited evidence of literature reporting *in vivo* experience of comparing only minimal invasive techniques with respect to its efficacy, efficiency and patient acceptance.

Aim of the Study

Thus, aim of the present Study was to compare Caries Removal using Brix 3000 Gel, Polymer Bur and Laser Technique in Primary Molars both clinically (for Efficiency) and microbiologically (for Efficacy) as well as assess fear and anxiety associated with the same.

Materials and Methods

Present *in vivo* study comprised of 30 healthy children aged between 5 - 9 years with occlusal caries reporting to the Department of Pedodontics and Preventive Dentistry, Rajarajeswari Dental College and Hospital, Bengaluru. Ethical approval to conduct the study was obtained from the Institutional ethical Committee. A written informed consent form was obtained from the parents of children who agreed to participate in the study. These children were selected applying following criteria:

Inclusion criteria

- Normal and healthy Children aged between 5 - 9 years.
- Primary Molars with broad occlusal cavitated lesion.

- Radiographically evidence of carious lesion confined to outer Dentin of occlusal surface.

Exclusion criteria

- Children with Special Health Care Needs.
- Primary Molars showing:
 - Clinical and radiological signs and symptoms of pulpal and periapical lesions.
 - Radicular resorption involving more than half root length.
 - Presence of developmental defects.

Procedure

Children were selected and were randomly divided into 3 groups according to the technique used for caries removal.

- Group 1: Brix 3000 Gel group (n = 10).
- Group 2: Polymer bur group (n = 10).
- Group 3: Laser group (n = 10).

In all the three groups: WongBaker Faces Pain Scale (WBFPS) was shown to patients before and after treatment and child was asked to point to the image that represented their level of comfort/discomfort (Figure 4).

Tooth selected was isolated with rubber dam and superficial dentin samples were collected both before and after using sterile spoon excavator and immediately transferred into a sterile vial containing saline for microbial culture. Time taken from start of caries removal till the cavity was confirmed to be free of caries was noted in all the groups.

Group 1 (Brix 3000 Gel)

Teeth in this group were treated using Brix 3000 (Chemomechanical agent) gel. Gel was applied using spoon excavator to the tooth and left undisturbed for two minutes according to the manufacturer’s instructions. Formation of oxygen bubbles on the dentin surface with higher turbidity of the gel is an indication of breakdown of collagen molecules and signals that removal of infected dentin tissue can be started [4]. Softened decay was excavated with spoon excavator by pendulum motion without pressure. Gel was reapplied, if needed until it presented a light colour, which indi-

cated nonexistence of the softened carious tissue. After the second application it was observed that only dentin “splinters” start to be removed by the excavator and dentin changed to a vitreous appearance (Figure 3). At this moment, there was a complaint of painful sensitivity by the patient, confirming the presence of affected dentin. Cavity was washed with 0.2% Chlorhexidine solution [4]. At the end, the cavity was wiped with a moistened cotton pellet and rinsed with water, teeth were restored with Type II GIC.

Group 2 (Polymer Bur)

Removal of carious dentin was performed with polymer bur running at slow speed without a water coolant. Caries was excavated with circular movements starting from the centre of lesion to the periphery as recommended by the manufacturer [5]. Excavation was stopped when the instrument became macroscopically abraded and blunted and was no longer able to remove tissue, teeth were restored with Type II GIC.

Group 3 (Laser Method)

Er:Cr:YSGG laser with frequency 20 Hz was set to obtain the power of 800W. Caries excavation was carried out under non contact mode using MZ8 laser tip under continuous water spray to decrease the energy density [6]. This facilitated to continue excavation of caries without change of operating parameters once set, teeth were restored with Type II GIC.

Microbiological investigation

Dentinal samples collected before and after each method were transported to the laboratory within 2 hours. Samples were then placed on Blood agar plates and incubated aerobically and assessed for number of colonies as CFU (Colony Forming Units) per sample in which each tooth had two readings, before and after the treatment [7] (Figure 5).

Results

Results were statistically evaluated. Statistical Package for Social Sciences [SPSS] for Windows, Version 22.0 Released 2013 was used to perform statistical analyses.

Kruskal Wallis Test followed by Mann Whitney Post hoc Analysis was used to compare the mean Wong Baker scores for pain and CFUs between 3 groups before and after treatment period. Laser



Figure 1: Armamentarium.

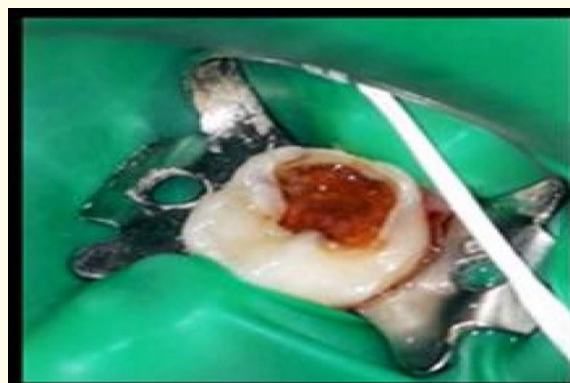


Figure 2: Tooth 75 with occlusal dental caries.

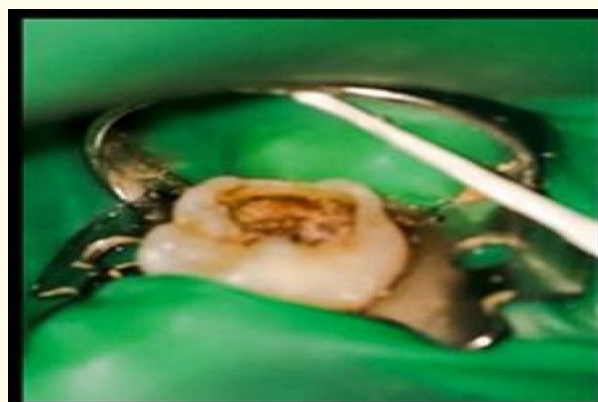


Figure 3: After caries excavation using Brix 3000 Gel.

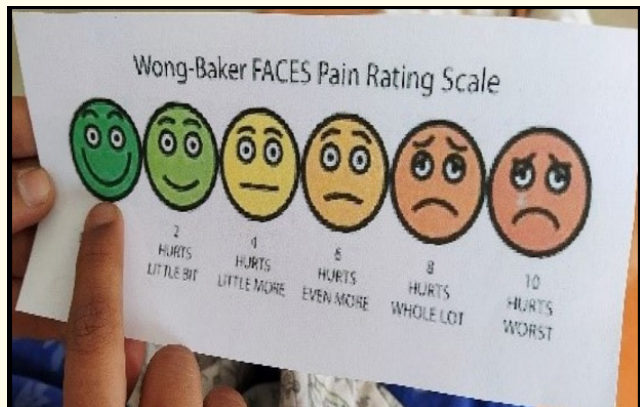


Figure 4: Wong baker faces pain rating scale.



Figure 5: Colony forming units (CFUs) before and after caries excavation.

method was significantly more efficacious than Brix 3000 Gel and Polymer Bur group. There was no significant statistical difference in terms of efficacy between groups 1 and 2 respectively (Table 1). Average pain score was significantly higher in Polymer Bur group compared to Brix 3000 Gel group and Laser group. Group 3 showed higher scores for pain as compared to group 1 (Table 2).

One-way ANOVA Test followed by Tukey’s Post hoc Analysis was used to compare the mean time taken (in mins) between 3

	Time	N	Mean	SD	Mean Diff	P-Value
Group 1	Before	10	5410.00	4845.72	5270.00	0.005*
	After	10	140.00	306.23		
Group 2	Before	10	6310.00	4770.85	6140.00	0.004*
	After	10	170.00	294.58		
Group 3	Before	10	3520.00	4485.98	3460.00	0.005*
	After	10	60.00	51.64		

Table 1: Comparison of mean CFUs before and after treatment in each study group.

Groups	Time	N	Mean	SD	Mean Diff	P-Value
Group 1	Before	10	1.60	1.58	1.20	0.01*
	After	10	0.40	0.84		
Group 2	Before	10	0.80	1.03	-1.40	0.008*
	After	10	2.20	1.75		
Group 3	Before	10	1.60	1.84	0.60	0.26
	After	10	1.00	1.05		

Table 2: Comparison of mean Wong Baker scores for pain before and after treatment in each study group.

groups, based on average time required Polymer bur method was significantly faster than Brix 3000 Gel group and Laser group. Average time required was not significantly different between groups 1 and 3 (Table 3).

Groups	N	Mean	SD	Min	Max	P-Value ^a	Sig. Diff.	P-Value ^b
Group 1	10	7.00	0.75	6.0	8.0	<0.001*	G1 vs G2	<0.001*
Group 2	10	3.30	0.59	2.5	4.0		G1 vs G3	0.009*
Group 3	10	6.00	0.75	5.0	7.0		G2 vs G3	<0.001*

Table 3: Comparison of mean time taken (in mins) between 3 groups.

Among the three agents (Brix 3000 gel, Polymer bur and Laser) following results were drawn from the Pilot study:

- Time taken for caries removal was found to be more in Brix 3000 gel group when compared to other groups.

- Polymer bur group was found to be more painful as compared to other groups.
- Laser group showed maximum antimicrobial efficacy as compared to other groups.
- Patient acceptance was highest in CMCR followed by laser and polymer bur respectively.

Discussion

Natural human enamel and dentin are still the best dental materials in existence. Modern dentistry has evolved into minimally invasive approach because they conserve a great part of the original, healthy tooth structure. These methods can be considered as viable alternatives to conventional rotary caries removal methods due to their conservative approach with no harm expected either on the healthy dentin or pulp tissue.

Since 1970s, various chemical compositions had been introduced as CMCR agents. Although these chemical agents appeared to be effective, each product had certain drawbacks. In 2003, a research project in Brazil led to the evolution of Papain gel (Papacarie). Cariecare was developed later in India, which was a papain based gel containing a purified enzyme with clove oil which is analgesic and antiseptic. In 2016, a new material had been found in Argentina named Brix 3000, also Papain-base, obtained from leaves latex and fruits of green papaya (*Carica papaya*). It is a dental product for non-traumatic caries treatment involving an enzymatic activity 3000 U/mg (U/mg: can be defined as the International units to measure a specific enzymatic activity or the concentration of enzymatic activity) in which papain was bio-encapsulated using EBE Technology (Encapsulating Buffer Emulsion) [7].

Currently available CMCR methods remove only the infected demineralised dentin because it does not have alpha-1-anti-trypsin, an antiprotease that prevents the proteolytic action. Chemomechanical agent Brix-3000 gel has selective action. Reduction in the bacterial count may be related to its microbiological effects, bactericidal and bacteriostatic action. In the current study, time required for the removal of dentinal caries in the Brix 3000 group was longer than that taken in the other groups. This might be attributed to the lesion consistency (soft, medium or hard) in which hard carious lesion required multiple application of Brix 3000 gel to decompose the infected dentin [7].

Use of tungsten carbide/diamond burs have been a norm and are designed to efficiently remove decalcified enamel and dentin. However, they do not readily differentiate between carious and normal dentin and the use of conventional bur is considered unsatisfactory because of its less conservative approach. In order to overcome this limitation, Polymer burs were introduced and are described as “dentin safe”, because it removes only carious dentin (self-limiting ability) and also has advantages like less heat generation, minimal discomfort during caries excavation and reduced chances of pulpal exposure during deep caries excavation. In our study, It was observed that caries excavation with Polymer bur was associated with mild discomfort compared to other two groups.

In the perennial quest for better dental treatment methods, various kinds of laser have been investigated and the performance of lasers in dentistry is indeed improving [8]. Lasers have proved to be very effective in not only removing caries but also in sterilizing cavities and good clinical as well as radiographical success of the treated teeth. Explosive interaction between water molecules and laser pulse on the tooth tissue surfaces causes rapid subsurface expansion of the interstitially trapped water that disrupts Enamel, Dentin and decay [6]. It is also reported to cause disruption of nerve terminals and myelin sheath in the dentin tubules and pulp core respectively, combined with degeneration of nerve terminals between the odontoblasts. Thus, it could be assumed that if use of laser could avoid anesthetic injection then complications related to administration of anesthesia such as allergy, toxicity, drug interactions and tongue and/ or lip biting could also be avoided. Protective eyewear by both patients and the staff is mandatory during the procedure. However, noise produced during the procedure is a limitation associated to both conventional drilling and laser irradiation [6].

Every method employed in the study had its own merits and demerits in terms of three objectives studied. In a clinical scenario, any method employed should be weighed against the treatment objective to be achieved. The following conclusions can be derived from our study.

Polymer burs are highly effective in treating shallow lesions and in situations which demand short treatment time, moderate cavities are best treated with laser irradiation whereas in deep cavities chemomechanical methods would be beneficial as anesthesia could

be avoided. CMCR method decreases the risk of pulp exposure and hence proves to be a viable alternative method in stepwise excavation technique. CMCR can also be used in children with Special Health Care Needs and uncooperative patients. Though laser technique has shown to be highly effective in completely sterilizing the lesion inturn increasing the chances of long term success of treatment, major drawback would be high cost of the device and other equipments which may limit their routine use in clinical practice.

Limitations of the Study

However, further studies need to be conducted on larger samples with long term follow up to prove the clinical reliability of these techniques.

Conclusion

Application of “minimally invasive dentistry” can be justified on the grounds that preservation of natural tooth structure is of paramount importance because no restorative material can adequately replace it. Dentistry has witnessed an era of development of new techniques and instruments that make conservative dentistry in true sense - A practical possibility and ultra conservative dentistry a reality.

At the beginning of 2020, the novel virus Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) appeared, causing the Coronavirus Disease (COVID-19).Emerging virus resulted in a global pandemic declared a Public Health Emergency of International Concern (PHEIC) by the World Health Organization (WHO) Director-General [9]. Although reported clinical manifestations of COVID-19 in children are generally less severe than adult patients, infants and young children remain vulnerable to infection and pose a significant transmission risk. COVID-19 can be transmitted through direct and indirect contact, mainly via respiratory droplets and splatter from saliva and blood through contact with mucous membrane. Most of the dental treatments are Aerosol Generating Procedures which have been associated with transmission of acute respiratory infections. Use of evidence-based biological atraumatic or minimally invasive treatment methods that require minimal or no Aeresol Generating Procedures for caries management in both Primary and Permanent dentition might be more appropriate under the current and near future circumstances of COVID-19 [10-30].

Clinical Significance

Chemomechanical caries excavation, polymer bur and laser irradiation follow the principle of minimally invasive dentistry and should be employed in day to day practice.

Bibliography

1. Ferraz C., *et al.* “Effectiveness of different removal methods of artificially demineralized dentin”. *Arquivos em Odontologia* 50.2 (2014): 56-62.
2. Khijmatgar S and Balagopal S. “Minimally Invasive Dentistry: Polymer Burs”. *Journal of Dentistry and Oral Biology* 1.2 (2016): 1009.
3. Ismail M and Haidar A. “Impact of Brix 3000 and conventional restorative treatment on pain reaction during caries removal among group of children in Baghdad city”. *JBCD* 31.2 (2019): 7-3.
4. Felizardo KR., *et al.* “Use of BRIX-3000 Enzymatic Gel in Mechanical Chemical Removal of Caries: Clinical Case Report”. *Journal of Health Science* 20.2 (2018): 87-93.
5. Aswathi KK., *et al.* “Comparison of efficacy of caries removal using polymer bur and chemomechanical caries removal agent: A clinical and microbiological assessment - An in vivo study”. *Journal of Indian Society of Pedodontics and Preventive Dentistry* 35 (2017): 6-13.
6. Bohari MR., *et al.* “Clinical Evaluation of Caries Removal in Primary Teeth using Conventional, Chemomechanical and Laser Technique: An in vivo Study”. *Journal of Contemporary Dental Practice* 13.1 (2012): 40-47.
7. Mafaz Mahdi Muhsin Ismail., *et al.* “Evaluation of the Efficacy of Caries Removal Using Papain Gel (Brix 3000) and Smart Preparation Bur (in vivo Comparative Study)”. *Journal of Pharmaceutical Sciences and Research* 11.2 (2019): 444-449.
8. Turkun., *et al.* “Bactericidal Effect of Er,Cr:YSGG Laser on Streptococcus mutans”. *Dental Materials Journal* 25.1 (2006): 81-86.
9. Mallineni SK., *et al.* “Coronavirus disease (COVID-19): Characteristics in children and considerations for dentists providing their care”. *International Journal of Paediatric Dentistry* 30 (2020): 245-250.
10. Al-Halabi., *et al.* “Assessment of paediatric dental guidelines and caries management alternatives in the post COVID-19 period. A critical review and clinical recommendations”. *European Archives of Paediatric Dentistry* (2020).
11. Shivasharan PR., *et al.* “Clinical Evaluation of Caries Removal in Primary Teeth Using Carie-care and SmartPrep Burs: An In vivo Study”. *Indian Journal of Oral Health and Research* 2 (2016): 27-31.

12. Mithra N H and Abhishek M. "Chemomechanical Caries Removal: A Conservative and Pain-Free Approach". *Advanced Research in Gastroenterology and Hepatology* 5.3 (2017): 555666.
13. Santos CR., et al. "Application of Er,Cr:YSGG Lasers in Cavity Preparation for Dental Tissues: A Literature Review". *World Journal of Dentistry* 3.4 (2012): 340-343.
14. Divya G., et al. "Evaluation of the Efficacy of Caries Removal Using Polymer Bur, Stainless Steel Bur, Carisolv, Papacarie - An Invitro Comparative Study". *Journal of Clinical and Diagnostic Research* 9.7 (2015): ZC42-ZC46.
15. Ammari MM., et al. "Efficacy of chemomechanical caries removal in reducing cariogenic microbiota: a randomized clinical trial". *Brazilian Oral Research* 28.1 (2014): 1-6.
16. Singh S., et al. "Comparative clinical evaluation of chemomechanical caries removal agent Papacarie® with conventional method among rural population in India - in vivo study". *Brazilian Journal of Oral Sciences* 10.3 (2011): 193-198.
17. Hamdi H Hamama., et al. "Caries Management: A Journey between Black's principals and Minimally Invasive Concepts". *International Journal of Dentistry and Oral Science* 2.8 (2015): 120-125.
18. Nalawade HS., et al. "Comparative evaluation of efficacy of chemomechanical and conventional methods of caries excavation in young permanent molar teeth: In vivo study". *Journal of Dental Research and Review* 6 (2019): 13-18.
19. Eren F., et al. "The Effect of Erbium, Chromium:Yttrium-Scandium-Gallium-Garnet (Er,Cr:YSGG) Laser Therapy on Pain During Cavity Preparation in Paediatric Dental Patients: A Pilot Study". *Oral Health and Dental Management* 12.2 (2013): 80-84.
20. Kohli A and Sahani S. "Chemicomechanical Caries Removal. A Promising Revolution: Say No to Dental Drills". *Journal of International Dental and Medical Research* 1.5 (2015): 158-161.
21. Kumar J., et al. "A comparative study of the clinical efficiency of chemomechanical caries removal using Carisolv® and Papacarie® - A papain gel". *Indian Journal of Dental Research* 23 (2012): 697.
22. Anegundi RT., et al. "A comparative microbiological study to assess caries excavation by conventional rotary method and a chemo-mechanical method". *Contemporary Clinical Dentistry* 3.4 (2012): 388-392.
23. Jingarwar MM., et al. "Minimal intervention Dentistry - A new frontier in clinical Dentistry". *Journal of Clinical and Diagnostic Research* 8.7 (2014): 4-8.
24. Motta LJ., et al. "Efficacy of Papacarie (®) in reduction of residual bacteria in deciduous teeth: a randomized, controlled clinical trial". *Clinics (Sao Paulo)* 69.5 (2014): 319-322.
25. Kumar KS., et al. "Chemomechanical caries removal method versus mechanical caries removal methods in clinical and community-based setting: A comparative in vivo study". *European Journal of Dentistry* 10 (2016): 386-391.
26. Prabhakar A., et al. "Clinical Evaluation of Polyamide Polymer Burs for Selective Carious Dentin Removal". *Journal of Contemporary Dental Practice* 4 (2009): 026-034.
27. AlHumaid J. "Efficacy and efficiency of papacarie versus conventional method in caries removal in primary teeth: An SEM study". *Saudi Journal of Medicine and Medical Sciences* 8 (2019): 41-45.
28. Corrêa FN., et al. "Chemical versus conventional caries removal techniques in primary teeth: A microhardness study". *Journal of Clinical Pediatric Dentistry* 31 (2007): 187-192.
29. Garcia-Contreras R., et al. "A comparative in vitro efficacy of conventional rotatory and chemomechanical caries removal: Influence on cariogenic flora, microhardness, and residual composition". *Journal of Conservative Dentistry* 17.6 (2014): 536-540.
30. Boston DW. "New device for selective dentin caries removal". *Quintessence International* 34 (2003): 678-685.

Assets from publication with us

- Prompt Acknowledgement after receiving the article
- Thorough Double blinded peer review
- Rapid Publication
- Issue of Publication Certificate
- High visibility of your Published work

Website: www.actascientific.com/

Submit Article: www.actascientific.com/submission.php

Email us: editor@actascientific.com

Contact us: +91 9182824667