

Efficacy of collagen fiber impregnated with tetracycline as an adjunct to scaling and root planning in metabolic control in type ii diabetic patients with periodontitis compared to conventional scaling and root planning-clinical trial.

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Abstract

Background of the study: Diabetes mellitus is a clinically and genetically heterogeneous group of metabolic disorder characterised by abnormally high levels of glucose in the blood. Periodontal intervention has a significant potential metabolic benefit in people with diabetes.

Aims and objectives: This study aims to determine the effect of locally delivered tetracycline which is locally delivered in the treatment of periodontitis and to know the effect on glycaemic control in individuals with type II DM.

Materials and methods: This study included 25 patients with type II diabetics with chronic periodontitis. In the control group which has 14 patients, scaling & root planning was done. Experimental group with 11 patients received scaling & root planning, with approximately 2 mg of Tetracycline Hydrochloride IP impregnated in type 1 fibrillar collagen of fish origin of approximately 25 mg was kept in the pocket greater than 6 mm.

Clinical assessment is by evaluation of reduction of probing depth, gain in clinical attachment, gingival and plaque index and also fasting blood sugar level, post-

prandial blood sugar and glycated haemoglobin level at baseline, first, second, third and sixth month.

Results: On comparison of gingival index scores, plaque scores, probing pocket depth and clinical attachment loss, significant difference was observed till sixth month. There was a reduction in Fasting blood sugar level, post-prandial blood sugar and glycated haemoglobin level at 3rd and 6th month in the experimental group.

Conclusion: The study showed that in patients with Type 2 DM, scaling and root planning and locally delivered tetracycline resulted in a reduction in all the clinical parameters and HbA1c levels.

Keywords: Type II Diabetes Mellitus, Chronic periodontitis, Scaling and root planning, Tetracycline.

Introduction

Periodontal disease is defined as “inflammatory disease of supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession or both.”¹

In 1993, Loe et al proposed periodontal disease as the sixth complication of diabetes mellitus². Taylor and Borgnakke suggested periodontal disease as a risk factor for poor metabolic control in people with diabetes mellitus.³ Administration of doxycycline and chemically modified tetracycline has brought significant reduction on the glycated haemoglobin level (HbA1c) and periodontal parameters.⁵

Materials and methods

The study protocol here in described was approved by college committee governing the use of human subjects in clinical experimentation. (Letter no: IEC/IRB No: ACDS/2158/18/14).

Study setting

Patients of both sexes & different age groups with a known history of Type 2 Diabetes reporting to the Department of Periodontology, Azeezia College of Dental Sciences & Research Meeyannoor Kollam, Kerala. Patients with the below mentioned criteria and gave informed consent to participate in the study were included.

Research Design: Randomised Clinical Trail

Sampling: Simple Random sampling

Sample size (n):

$$n = \frac{2(Z_{\alpha} + Z_{\beta})^2 + (1 + (m - 1)p)}{\frac{m(\mu_1 - \mu_2)}{\sigma}}$$

Participants

Inclusion Criteria

The criteria for inclusion in the study were:

- Patients with type II Diabetes with glycated haemoglobin values: >6%.
- No major complications associated with diabetes.
- Was not under any systemic antibiotic within the last 3 months.
- No periodontal therapies done 6 months before the study.
- Clinical attachment level ≥ 5 mm

Exclusion Criteria

- Patients using antimicrobial mouth rinses within 2 months of the baseline visit or on routine basis.
- Patients with history of having allergy to tetracycline.
- Pregnancy or nursing mothers.
- Patients in which the depth of the periodontal pockets corresponded to the apex of the tooth.

The study consists of 2 groups

Subjects include both women and men. Subjects will be randomly assigned into two groups of 12 in test and 12

in control groups. Data of brushing habits, duration of their diabetes, number of missing teeth, denture usage will be recorded.

Group I- Experimental group: consisted of 12 Diabetic patients in which, scaling & root planning was done & adjunct to scaling & root planning, collagen fibre impregnated with tetracycline was kept in the pocket.

Group II- Control group: consisted of 12 Diabetic patients in which, only scaling & root planning was done.

Clinical parameters

All clinical parameters were recorded by one examiner. These parameters will be recorded at baseline (day 0) and at 1st, 2nd, 3rd & 6th months after the periodontal treatment in both groups. Recordings will be made from the buccal, lingual and two interproximal surfaces of each tooth.

PerioCol® TC manufactured by (EUCARE PHARMACEUTICALS (P) LTD, Chennai, India) was used in the test group. Each vial contains 2 mg of Tetracycline Hydrochloride IP impregnated in type 1 fibrillar collagen of fish origin of approximately 25 mg that has been sterilized by gamma irradiation. Collagen is used as the vehicle for drug delivery. It can be stored in a dry place at between 5 0 C and 25 0 C. It is gamma sterilized with a shelf life of 2 years. Its half-life is 8-11 hours.

Pre-treatment protocol

The patients, who were selected and gave their approval for the treatment were educated and motivated with more emphasis on proper oral hygiene maintenance. The selected cases of Type 2 diabetic patients were randomly assigned to either experimental or control group. Pre-operative and Post-operative clinical photographs were taken.

The periodontal parameters recorded were Plaque index, probing pocket depth from gingival margin to base of pocket, Gingival index, clinical attachment level measurement from CEJ as a reference point to the base of pocket at baseline (day 0) and at 1st, 2nd, 3rd and 6th months following the periodontal treatment in both groups. Recordings were made from the buccal, lingual and two interproximal surfaces of each tooth. For the metabolic assessment, venous blood samples were taken from each patient and analysed for fasting blood sugar, 2-hr post prandial blood sugar & glycated haemoglobin.

Procedure

Control group

Subjects receiving scaling and root planning with ultrasonic scalers and Gracey's curette. Patients were given oral hygiene instructions. Modified Bass brushing demonstrated. Patients were recalled after 1 week to evaluate the oral hygiene status. If oral hygiene status is not found satisfactory, standard oral hygiene measures were again done.

Experimental group

Subjects receiving standard periodontal therapy and tetracycline fiber were placed at selected sites.

In periodontal pockets found greater than 6 mm fibre was moistened with normal saline and inserted to closely approximate the pocket anatomy which is in close contact with the base of the pocket. If necessary, periodontal pack was placed. The fibre need not to be removed at any time since it is biodegradable. Patients were given oral hygiene instructions. Modified Bass brushing demonstrated. Patients were asked to come after 1 week to evaluate the oral hygiene status and periodontal pack removed.

Patients of both the groups were then recalled at 1st month, 2nd month, 3rd month and 6th month post-operatively for evaluation, maintenance care and

recording of the clinical parameters. On every visit, ultrasonic scaling was done after recording the clinical parameters. For the metabolic assessment, venous blood samples were taken from each patient which was then analysed for FBS, 2-hr PPBS& glycated haemoglobin on 3rd and 6th month.

Statistical analysis

In this research we had two treatment groups, control group treated with scaling and root planning and experimental group treated with scaling and root planning and collagen fibre impregnated with tetracycline. In the test group, we had 11 patients and in the control group 14 patients respectively. The comparability of the groups was tested by chi-square test and t-test.

For comparison of gingival and plaque index between test and control group, we had used the non-parametric test namely Mann-Whitney U test and for the comparison between pocket depth, clinical attachment level, FBS, PPBS and HbA1C students t-test were used because pocket depth and clinical attachment are in millimetres and FBS, PPBS in mg/dl and HbA1C in percentage.

Tables

Comparison between experimental and control group on various parameters:

Table 1: Comparison between experimental and control group on Fasting Blood sugar at 6th month

Group	Mean	Standard deviation	t-value	P value	Significance
Experimental	125.22	20.72	0.830	0.417	Not Significant
Control	132.46	19.71			

There was a significant reduction in fasting blood sugar level during the 6th month follow-up.

Table 2: Comparison between experimental and control group on post-prandial blood sugar at 6th month

Group	Mean	Standard deviation	t-value	P value	Significance
Experimental	178.89	43.49	1.058	0.303	Not Significant
Control	198.69	42.93			

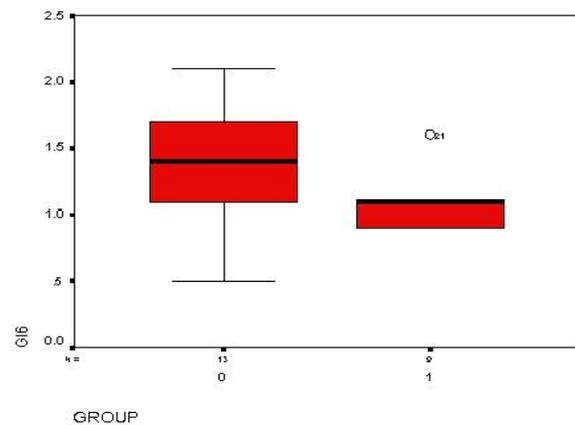
There was a significant reduction in post-prandial blood sugar level during the 6th month follow-up.

Table 3: Comparison between experimental and control group on Glycated Haemoglobin level at 6th month

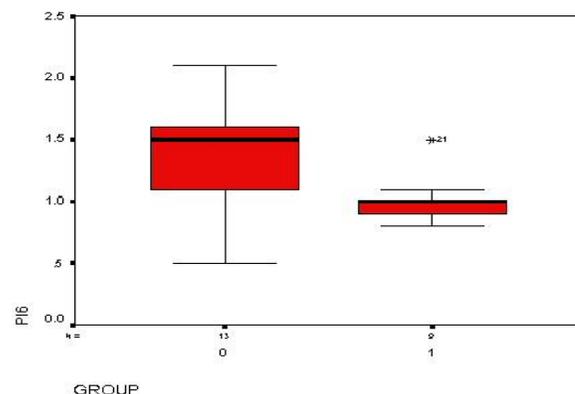
Group	Mean	Standard deviation	t-value	P value	Significance
Experimental	7.289	1.821	1.023	0.318	Not Significant
Control	7.915	1.055			

There was a significant reduction in glycated haemoglobin level during the 6th month follow-up.

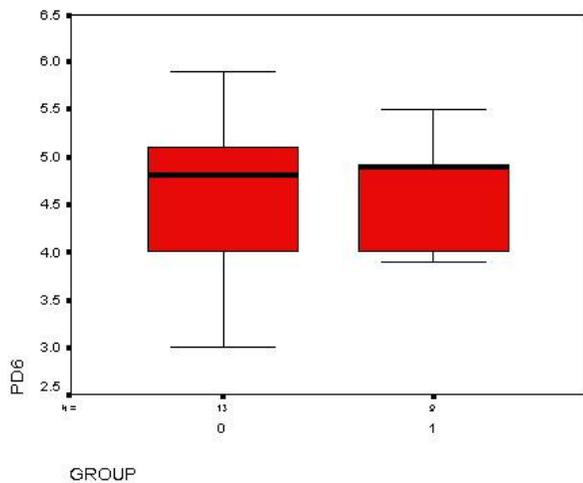
Graphs 1: Comparison between experimental and control group on gingival index at 6th month



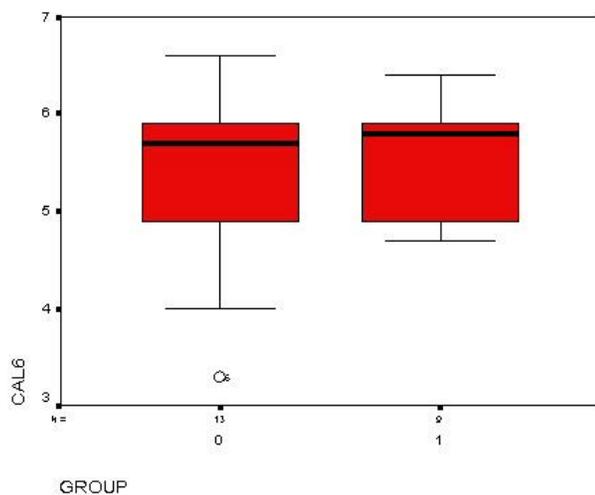
Graph 2: Comparison on plaque index at 6th month



Graph 3: Comparison on probing pocket depth at 6th month



Graph 4: Comparison on clinical attachment level at 6th month



Results

The study was carried out at the Department of Periodontology, Azezia College of Dental Sciences & Research, Meeyanoor, Kollam.

A total of 25 patients having Type 2 diabetics with chronic periodontitis participated in the study. The patients were randomly assigned to either control group or experimental group. Of the 25 patients taken up in the study, 22 patients returned for the complete follow-up routine. The remaining 3 patients dropped out during the last month follow up phase of the study. The study group

comprised of 9 males and 5 females in control group and 5 males and 6 females in test group.

The mean age of the patient in the control group was 54.64 with standard deviation 8.76. The mean age of the patient in the test group was 56.45 with standard deviation 9.22.

Discussion

Periodontitis develops when the balance occurs between the microbial attack and the host defence are affected¹⁰. Mechanical therapy alone may not be able to eliminate the pathogenic bacteria because of their location within gingival tissues or in other areas inaccessible to periodontal instruments.¹¹

Prevalence, severity and progression of the periodontal problems are higher in diabetic patients¹² Determination of glycohemoglobin levels helps us to get an estimate of the average blood glucose level over time. Glycohemoglobin is formed in erythrocytes as a product of the non-enzymatic reaction between the haemoglobin protein, which carries oxygen molecules, and glucose¹³. This binding of glucose to haemoglobin is highly stable; thus, haemoglobin remains glycated for the life span of the erythrocyte, approximately 123 ± 23 days¹⁰ the recommended haemoglobin A1c target value for people with diabetes is $<7.0\%$ (normal value is $<6\%$) In periodontal disease, increased circulating levels of tumour necrosis factor- α (TNF- α), interleukin (IL)-6 and high-sensitivity capsule reactive protein (hs-CRP) seen can worsen insulin resistance and impair glycaemic control in type 2 diabetic patients.⁴

Several studies of diabetic subjects with periodontal problems have shown improvements in glycaemic level after scaling and root planning combined with adjunctive systemic doxycycline therapy The magnitude of change is often about 0.9–1.0% in the haemoglobin A1c test¹⁵. This study was done to compare the changes in

glycaemic control of a group of patients with type II DM after local drug delivery along with scaling and root planning to a control group with type II DM with only scaling and root planning.

Patients with periodontitis usually have good respond to mechanical periodontal therapy and derive little benefit from antibiotic therapy¹⁶

The local delivery of antimicrobial therapy to periodontal pockets can administer more drugs at the target site and decrease the exposure of total body to the drug and there will be sustained and controlled release of antimicrobial in the periodontal pockets¹⁷. Therefore, the purpose of this study was to evaluate the clinical effect of a local delivery system with tetracycline as an adjunct to periodontal therapy and specifically root planning in type II DM patients.

Tetracycline has antiproteolytic activity, inhibition of collagenase activity and bone resorption, anti-inflammatory properties to suppress PMN activity, and scavenging action on reactive oxygen metabolites.⁶

Tetracycline is incorporated into a variety of delivery systems (non resorbable or bioresorbable) and is inserted into periodontal pockets which include hollow fibres, ethylene vinyl acetate copolymer fibres, ethyl cellulose fibres, acrylic strips, collagen preparations, and hydroxypropyl cellulose films.⁸The efficacy of the modified collagen matrix and tetracycline over scaling and root planning could be due to the availability of a modified collagen matrix to accelerate tissue restructuring, the sustained delivery of a potent drug (tetracycline) that eradicated periodontopathic microorganisms, and the ability of tetracycline to inhibit bacterial collagenases⁹

Oral tetracyclines can cause potential unwanted effects and care must be taken to prevent interactions with other drugs that are taken concurrently. Such problems are

minimised, when the drugs are incorporated into slow-release, controlled formulations which are now being researched and marketed for intra-oral use¹⁸. This avoids most of the problems associated with systemic therapy by limiting the drug to its target site with little systemic uptake.⁷

On comparison of gingival index scores in test and control group, statistically significant difference was observed from baseline till third month. This was due to the efficacy of the treatment done in the test group. The difference in mean value between test and control group at 6th month was clinically significant, but statistically it was not significant. This may be because of inadequate sample size. This is in accordance by the studies by Komal et al (2013)²¹, which showed significant improvement was obtained in all clinical variables when PeriochipTM placement as an adjunct to SRP, when compared to SRP alone.

On comparison of plaque index scores in test and control group, highly statistically significant difference was observed from baseline till sixth month. This was due to the efficacy of the treatment done in the test group. The decrease in plaque index scores was greater on the test side, which agrees with the studies done by Komal et al (2013)²¹.

There was a mean reduction in probing depth in control group from baseline till 6th month. This was in accordance with the studies by Aljateel et al(2014)¹⁴, which showed periodontal surgery after scaling and root planning yielded greater probing depth reduction as compared to periodontal surgery without initial scaling and root planning.

On comparison of probing pocket depth in test and control group, statistical statistically significant difference was not observed in baseline, first, second, third and sixth month. This may be due to the fact that

local drug delivery may not be effective in deep periodontal pockets greater than 7 mm. Surgical intervention may be needed. This result was in accordance with the studies done by Dr. Arthur et al (2005)²⁰, where the improvements in PD and CAL were due to the improvement from SRP alone when using tetracycline, minocycline, metronidazole, and chlorhexidine. But the studies by Antonio et al (2004)²² reported that doxycycline hyclate subgingivally delivered produces favourable clinical results to periodontal therapy in type 1 DM patients and Rupali Kalsi et al (2001)²³ reported that local drug delivery combined with SRP appears to provide more reduction in probing depth compared with SRP alone.

On comparison of clinical attachment level in test and control group, statistically significant difference was not observed in baseline, first, second, third and sixth month. This result was in accordance with the studies done by Dr. Arthur et al (2005)²⁰. But the studies by Antonio et al (2004)²² and Rupali Kalsi et al (2001)²³ reported that locally delivered antimicrobial drug combined with SRP appears to provide additional benefits compared with SRP alone. Studies by Paolantonio et al (2008)²⁴ reported significant reduction in probing pocket depth and a clinical attachment gain when CHX chip was used with SRP compared to SRP alone and Rupali Kalsi et al (2001)²³ where 10% Doxycycline hyclate (ATRIDOX), tetracycline hydrochloride (PERIODONTAL PLUS AB), minocycline hydrochloride (ARESTIN), and chlorhexidine gluconate (PERIOCHIP) were used adjunct to SRP compared to SRP alone.

The mean reduction in FBS and PPBS in control group agrees with the studies by Mine Kiran et al (2005)²⁵, in which they reported that non-surgical periodontal treatment was associated with improved glycaemic

control in type 2 patients and could be used with the standard measures for the diabetic patient care.

There was a difference in fasting blood sugar and post-prandial blood sugar level at 3rd and 6th month between experimental and control group and the lower value was for experimental group showing efficacy of the experimental treatment but it was not statistically significant which may be due to inadequate sample size. This is comparable to studies by Dr. Arthur et al (2005)²⁰ where a significant reduction in the fasting blood sugar, post-prandial sugar level and HbA1c levels in the experimental group compared to control group was obtained, but it was not statistically significant.

There was a difference in glycated haemoglobin level at 6th month between experimental and control group and the lower value was for experimental group showing efficacy of the experimental treatment but it was not statistically significant. This is in accordance with the studies by Correa et al (2010)⁴, where they showed that periodontal treatment reduced HbA_{1c} and hs-CRP levels. The findings from this study help to deduce that locally delivered tetracycline can be used as an effective treatment modality when used in combination with scaling and root planing in type II diabetics. In this study, significantly better clinical results at 6 months were obtained for the adjunctively treated tetracycline groups over the control group.

Conclusion

The study clearly showed that in patients with Type II DM, treatment of periodontitis incorporating scaling and root planing and local drug delivery of tetracycline resulted in a significant reduction in all the clinical parameters like probing depth, clinical attachment level, the gingival and plaque index and a short-term reduction in levels of HbA_{1c}. Also, hyperglycaemia was reduced in patients in both groups.

The data from this study, clearly shows that type 2 diabetics had a good periodontal short-term response to non-surgical periodontal therapy, and this response may have been increased by the use of locally delivered tetracycline. Hence oral and periodontal health should be considered as integral components of diabetes management.

References

1. Newman MG, Takei TH, Carranza HH. *Clinical Periodontology* 2003;10th ed. Philadelphia: Saunders (An imprint of Elsevier)
2. Løe H. Periodontal disease: the sixth complication of diabetes mellitus. *Diabetes Care* 1993; 16(1):329-334.
3. Taylor GW, Borgnakke WS. Periodontal disease: associations with diabetes, glycemic control and complications. *Oral Dis* 2008; 14(3):191-203.
4. Correa FOB, Gonçalves D, Figueredo CMS, Bastos AS, Gustafsson A, Orrico SRP. Effect of periodontal treatment on metabolic control, systemic inflammation and cytokines in patients with type 2 diabetes. *J Clin Periodontol* 2010; 37: 53–58
5. Subodh P. Gaikwad, Abhijit N. Gurav, Abhijeet R. Shete, Hitesh M. Desarda. Effect of scaling and root planing combined with systemic doxycycline therapy on glycemic control in diabetes mellitus subjects with chronic generalized periodontitis: a clinical study. *J Periodontal Implant Sci* 2013;43:79-86..
6. Martorelli de Lima AF, Cury CC, Palioto DB, Duro AM, Da Silva RC, Wolff LF. Therapy with adjunctive doxycycline local delivery in patients with type 1 diabetes mellitus and periodontitis. *J Clin Periodontol* 2004; 31: 648–653
7. Rifkin BR, Vernillo AT, Golub LM. Blocking periodontal disease progression by inhibiting tissue-destructive enzymes: a potential therapeutic role for tetracyclines and their chemically-modified analogs. *J Periodontol* 1993; 64(8 Suppl):819-27.
8. Surinder Sachdeva and Vipin Agarwal .Evaluation of commercially available biodegradable tetracycline fiber therapy in chronic periodontitis. *J Indian Soc Periodontol* 2011 Apr-Jun; 15(2): 130–134
9. Campus G, Salem A, Uzzau S, Baldoni E, Tonolo G. Diabetes and periodontal disease: a case-control study. *J Periodontol* 2005; 76: 418–425
10. Slots J, Rams TE. Antibiotics in periodontal therapy: Advantages and disadvantages. *J Clin Periodontol.* 1990;17:479–93.
11. Llambe's F, Silvestre F-J, Herna'ndez-Mijares A, Guiha R, Caffesse R. Effect of nonsurgical periodontal treatment with or without doxycycline on the periodontium of type 1 diabetic patients. *J Clin Peridontol* 2005; 32: 915–920
12. Manvi C Agarwal, Chaubey KK, Rishi Agarwal, Ellora Madan, Thakur RK, Swati Agarwal. Glycated Hemoglobin: Link Between Diabetes And Periodontics. *TMU J. Dent* Apr – June 2015;Vol.2(2)
13. Seymour RA, Heasman PA. Tetracyclines in the management of periodontal diseases. A review. *J Clin Periodontol.* 1995 Jan;22(1):22-35.
14. Aljateeli M, Koticha T, Bashutski J, Sugai JV, Braun TM, Giannobile WV, Wang H-L. Surgical periodontal therapy with and without initial scaling and root planing in the management of chronic periodontitis: a randomized clinical trial. *J Clin Periodontol* 2014; 41: 693–700
15. Mealey BL, Ocampo GL. Diabetes mellitus and periodontal disease. *Periodontology* 2000 2007;44:127-53

16. Caton JG, Ciancio SG, Blieden TM, Bradshaw M, Crout RJ, Hefti AF, Massaro JM, Polson AM, Thomas J, Walker C. Subantimicrobial dose doxycycline as an adjunct to scaling and root planing: post-treatment effects. *J Clin Periodontol* 2001; 28: 782–789.
17. Divya P.V, K. Nandakumar "Local Drug Delivery--- Periocol" In *Periodontics; Trends Biomater. Artif. Organs*, 2006; 19(2):74-80
18. Vijan P, Kolte A, Yeltiwar RK. A review local drug delivery in *Periodontology Local drug delivery system. JISP*. 1998; 2(1): 10-2.
19. Al-Mubarak S, Ciancio S, Aljada A, Awa H, Hamouda W, Ghanim H, Zambon J, Boardman TJ, Mohanty P, Ross C, Dandona P: Comparative evaluation of adjunctive oral irrigation in diabetics. *J Clin Periodontol* 2002; 29: 295–300.
20. Dr. Arthur J. Bonito, Linda Lux, Kathleen N. Lohr. Impact of Local Adjuncts to Scaling and Root Planing in Periodontal Disease Therapy: A Systematic Review. *J Periodontol* 2005;76:1227-1236.
21. Komal Puri, Vidya Dodwad ,Kishore Bhat, Nikhil Puri. Effect of controlled-release Periochip™ on clinical and microbiological parameters in patients of chronic periodontitis. *Journal of Indian Society of Periodontology* 2013 ; 17 (5) : 605-611
22. Newman G, Henry H, Takei, Perry R, Klokkevold, Fermin A Carranza. Carranza's *Clinical periodontology* 11th edition.
23. Rupali Kalsi, K. L. Vandana, and Shobha Prakash . Effect of local drug delivery in chronic periodontitis patients: A meta-analysis. *J Indian Soc Periodontol* .2011 Oct-Dec;15(4):304-309
24. Michele Paolantonio, Matteo D'Angelo, Roberto Felice .Clinical and Microbiologic Effects of Subgingival Controlled-Release Delivery of Chlorhexidine Chip in the Treatment of Periodontitis: A Multicenter Study . *Journal Of Periodontology* February 2008;79(2): 271-282
25. Kiran M, Arpak N, Unsal E, Erdog˘an MF. The effect of improved periodontal health on metabolic control in type 2 diabetes mellitus; The effect of improved periodontal health on metabolic control in type 2 diabetes mellitus. *J Clin Periodontol* 2005; 32: 266–272. Chang CH: Clinical applications of orthodontic bone screw in Beethoven orthodontic center, *Int J Orthod Implantol* 23:50–51, 2011 Almeida, M. R. (2019). Biomechanics of extra-alveolar mini-implants. *Dental Press Journal of Orthodontics*, 24(4), 93–109.