REVIEW ARTICLE

Fibronectin as a Root Surface Biomodifation Agent: Is it Worth it!!

Kratee Sharma[1], Mamta Singh[2], Zaby Fatima[3], Vaibhava Raaj[4]

ABSTRACT

Various physical and chemical agents have been introduced for the modification of the root surface known as biomodification procedures in order to detoxify, decontaminate, and demineralise the root surface. Fibronectin is involved in the attachment of gingival fibroblasts to root surface, appear to offer potential for retarding epithelial down growth and hence promotes root biomodification and regeneration. With this intention in mind, EBSCO HOST was searched for entries since 1966 – 2014, which included:- Journal of Periodontology, Annals of Periodontology, Periodontology 2000, Journal of Clinical Periodontology, International Journal of Periodontics and Restorative dentistry, Journal of Indian Society of Periodontology and Journal of Periodontal Research. A total of 12 studies were reviewed, out of these 12 studies, only, 6 reported evidence of regeneration for fibronectin. It was found that the role of fibronectin as a root biomodifying agent in regeneration is still unpredictable and doubtful.

Keywords: Root biomodification, regeneration, fibronectin

How to cite this article: Kratee Sharma, Mamta Singh, Zaby Fatima, Vaibhava Raaj. Fibronectin as a Root Surface Biomodifation Agent: Is it Worth it!!. International Journal of Contemporary Medical Research 2015;2(5):1198-1201.

[1]Third Year Post Graduate Student, [2]Second Year Post Graduate Student, [3]First Year Post Graduate Student, Department of Periodontics, Kothiwal Dental College and Research Centre, Mora Mustaqueem, Kanth Road, Moradabad, [4]Second Year Post Graduate Student, Department Of Periodontics, Chandra Dental College & Hospital, Barabanki, Uttar Pradesh, India.

Corresponding author: Kratee Sharma, A-114, Jigar Colony, Moradabad, Uttar Pradesh, India

Source of Support: Nil

Conflict of Interest: None

INTRODUCTION

Periodontitis is an inflammatory process of bacterial origin that affects the periodontal tissues, provokes the destruction of supporting tissues of the teeth.[1] It thus, produces substantial changes on the root surface which is referred to as 'pathologically exposed'[2] root surface In this area, the extrinsic and intrinsic fibres are destroyed by plaque induced inflammation, followed by the down growth of exposed junctional epithelium.[3]

Plaque, calculus and cytotoxic substances penetrate the pathologically exposed root surface and act as physical barrier inhibiting the new attachment and providing a substrate for bacterial growth.[4] Such surfaces are not biocompatible with periodontal cells, the proliferation of which is pivotal for periodontal wound healing.

The objective of periodontal therapy is aimed at elimination of periodontal disease, restoration of the periodontal tissues to a healthy, functional state and the subsequent maintenance of these tissues.[5] This type of regeneration is described by the term 'New attachment'.

New attachment is the embedding of new periodontal ligament fibres on to new cementum previously denuded by the periodontal disease.[6] Plaque, calculus, infected cementum and alterations in mineral density and composition of root interfere with new attachment.[2] These obstacles cannot be eliminated by scaling and root planing alone. Nevertheless, this procedure leads to smear layer formation that impairs and hinders the periodontal healing and regeneration. Hence, root biomodification procedures, have been introduced by using a variety of agents in order to facilitate new attachment.[2]

There have been controversial evidences of new attachment following root surface modification by fibronectin. So, there is a need to evaluate it as a root biomodifying agent**.**

MATERIALS AND METHODS[7]

EBSCO HOST was searched for entries since 1966 – 2014, which included these journals:- Journal of Periodontology, Annals of Periodontology, Periodontology 2000, Journal of Clinical Periodontology, International Journal of Periodontics and Restorative dentistry, Journal of Indian Society of Periodontology and Journal of Periodontal Research.

To identify studies not found in the databases search, certain issues of the following journals were searched manually: Journal of Periodontology, Journal of Clinical Periodontology, Journal of Indian Society of Periodontology and Journal of Periodontal Research, Chronicles of Dentistry, Indian Journal of Oral Sciences, text books.

Inclusion criteria

Randomized controlled trials in systemically healthy human subjects; comparative, histologic and animal studies, narrative reviews published in English; presenting any modality of root surface biomodification.

Exclusion criteria

Studies lacking baseline–outcome comparisons; with insufficient data; with more than one variable in addition to root surface biomodification; and case reports, because of their weaker clinical evidence.

RESULTS

A total of 12 studies were reviewed, out of these 12 studies, only 6 reported evidence of regeneration for fibronectin. The result of crucial observations noticed has been presented in form of Table No. 1.

DISCUSSION

Fibronectin is a high-molecular weight glycoprotein which is widely distributed throughout the body and is found in soluble form in plasma and in an insoluble form in the extracellular matrix.[8] Fibronectin plays a major role in cell adhesion, growth, migration, differentiation, and it is important for processes such as wound healing and embryonic development.

It forms covalent links to different types of collagen and to fibrin which enables it to play a role in the early phase of wound healing, forming substrate for factor XIIIa in a clot.[9]

Fibronectin promotes cell to cell adhesion and mobility (Pealstein, Yamada & Weston) and regulates cell matrix interaction. In particular, promotes migration, chemoattraction, adhesion, attachment and synthetic activity of fibroblasts.[10]

Fibronectin and laminin are involved in the attachment of gingival fibroblasts to root surface[11], appear to offer potential for retarding epithelial down growth. These activities have led to attempts to use fibronectin to hasten the reattachment of periodontal tissues to root surfaces in the surgical treatment of periodontal disease.[11,12]

Fibroblast attachment to freshly cleaned root surfaces is enhanced following topical application of fibronectin.[13] This accelerated attachment was suggested to be the result of opsonization of root bound endotoxin[14] or related function of fibronectin in the initial stages of cell attachment, role of fibronectin in tissue morphogenesis is to allow for initial extra cellular matrix and cell attachment.[15]

Fibronectin is necessary for fibroblast adhesion and connective tissue organization in healing wounds.[13] In acid treated teeth fibronectin mediated thin linkage of fibrin with exposed collagen. The growth of gingival fibroblasts and gingival epithelial cells on dentin surfaces prepared with tetracycline hydrochloride can be modulated by fibronectin & laminin[16]

In citric acid conditioning followed by fibronectin application – fibrous reattachment is enhanced at the expense of epithelial down growth and occurs directly to both new and old cementum and exposed dentin often in a functional manner (perpendicular to the root surface) There was no obvious advantages in increasing the concentration of fibronectin above the plasma level (0.38 mg/ml). Significantly higher

Reference	Subjects/ Sample	Procedure / interventions	Observation			Inference
			Clinical	SEM	Histological	
Caffesse et al	Human, in vivo study, N= 29.	Modified widman flap + Citric acid + Fibronectin	Reduction in probing pocket depth, gain in clinical attachment level.	-	-	Modified Widman flap alone or in combination with citric acid and fibronectin, significantly reduces probing pocket depth and increases clinical attachment. However, the changes achieved with citric acid and fibronectin are statistically greater than those obtained with the flap alone.
Alger et al	Human, in vivo study, block sectioning, 90 days duration, N= 22.	**Test A:** Mucoperiosteal flap with tetracycline hydrochloride **Test B:** Mucoperiosteal flap with tetracycline and fibronectin.	-	-	3 of the 7 specimens in Test group A with connective tissue attachment. In Test group B, 4 of the 5 specimens with no reattachment.	Addition of fibronectin to tetracycline treated teeth did not enhance connective tissue attachment, and appears to inhibit it.

Table-1: Evaluation of efficacy of fibronectin in root biomodification[7]

reduction in probing pocket depth and increase clinical attachment level was observed (that is citric acid and fibronectin than in control). The result of the treatment, showed that combination of citric acid and fibronectin was encouraging.[17] Trombelli et al.[18] carried out complete root coverage of denuded root surface using expanded polytetrafluoroethylene membrane in conjunction with tetracycline root conditioning and fibrin-fibronectin glue application. Results showed the disappearance of the anatomic defect and an increase in the amount of keratinized gingiva.

Dean et al.[19] determined the migrational behavior of fibroblasts, which is critical for the maintenance and healing of the periodontium. The purpose of this study was to determine, in vitro, the differences found in gingival fibroblast migration on the following substrates: fibronectin, laminin, bovine serum albumin, or plastic. The results showed that cell migration was enhanced on fibronectin substrates.

An *in vitro* study was conducted to determine the binding of fibronectin from three different sources, that is endogenous EDTA-plasma, endogenous serum and exogenous commercial purified human fibronectin in PBS buffer, to demineralized and non-demineralized root powder.[20]

The preliminary data suggest that additional plasma and serum factors may facilitate the binding of fibronectin to root powder. High levels of in fibronectin purified human fibronectin in blood do not necessarily indicate that fibronectin is available for binding to the root surface during periodontal surgery.[20]

Another study was conducted to investigate the presence and distribution of fibronectin in normal human cementum and determined whether its distribution is altered in periodontitis. Changes in cementum due to periodontitis include changes in the distribution and morphology of fibronectin.

These changes may influence the ability for regeneration and connective tissue attachment onto periodontally affected root surfaces.[21]

However, in most of the studies on fibronectin, no stastistically significant differences were seen, indicating unpredictable role of fibronectin in regeneration.

CONCLUSION

Within the limitations of this review, it is possible to conclude that the application of fibronectin as a root biomodification provides minimal clinical benefit with respect to gain in attachment levels or reduction in probing pocket depths. Thus, its role in regeneration is still unpredictable and contoversial.

Therefore further studies are needed to ascertain the positive effect of fibronectin as a root biomodification agents on regeneration in larger sample size.

REFERENCES

1. Sucheta A, Darshan BM, Prasad R, Ashit BG. Root biomodification- A boon or bane ? *Indian J Stomatol* 2011; 2:251-255.
2. Eide B, Lie T, Selvig KA. Surface coating on dental cementum incident to periodontal disease. A Scanning electron microscopic study. *J Clin Periodontol* 1983;10:157-163.
3. Kelpic TJ, Oleary TJ, Kafrawy AH. Total calculus removal: An objectionable objective? *J Periodontol* 1990; 61:16-20.
4. Adrina PA, Edward CA, Deboever JA, Loeshe WJ. Ultra structural observations on bacterial invasion in cementum and radicular dentin of periodontally diseased human teeth. *J Periodontol* 1998;59:493-503.
5. Lafferty TA, Gher ME, Gray JL. Comparative SEM study on the effect of acid etching with tetracycline HCL or citric acid on Instrumented periodontally involved human root surfaces. *J Periodontol* 1993; 64:689-693.
6. Aravind B, C Koshy, Bhatt GS, Bhatt MK. Root conditioning –A review. *J Ind Soc Periodontol* 2003; 6(2):88-93.
7. Sharma K, Chaubey K.K, Sharma S, Trehan M. Current status of root biomodification agents in regeneration. *University J Dent Scie* 2015;1:13-20.
8. http://en.wikipedia.org/wiki/Fibronectin
9. Yamada KM and Olden K. Fibronectins-adhesive glycoproteins of cell surface and blood. *Nature* 1978;275:179-184.
10. Yamada KM, Kennedy DW, Kimata K and Pratt RM. Characterization of fibronectin interactions with glycosaminoglycans and identification of active proteolytic fragments. *J Biol Chem* 1980; 255:6055–6063.
11. Terranova VP and Martin GR. Molecular factors determining gingival tissue interactions with tooth structure. *J Periodontal Res* 1982*;* 17:530–533.
12. Caffesse RG, Smith BA, Nasjlet CE and Lopatin DE. Cell proliferation after flap surgery, root conditioning and fibronectin application. *J Periodontol* 1987; 58:661–666.
13. Aleo J, Derenzis T, Farber P. In vitro attachment of human gingival fibroblasts to root surfaces. *J Periodontol* 1975;46:639-645.
14. Schwarz F, Putz N, Georg T, Reich E. Effect of an Er:YAG laser on periodontally involved root surfaces: an in vivo and in vitro SEM comparison. *Lasers Surg Med* 2001;29:328–335.
15. Ruoslahti E and Hayman EG. Immunochemical and collagen-binding properties of fibronectin. *Ann New York Acad Sci* 1957;312:178–191.
16. Polson AM, Proye MF. Fibrin linkage: A precursor for new attachment. *J Periodontol* 1983;54:141-147.
17. Smith BA, Smith JS, Caffesse RG, Nasjleti CE, Lopatin DE. And Kowalski CJ. Effect of citric acid and various concentrations of fibronectin on healing following periodontal flap surgery in dogs. *J Periodontol* 1987*;* 58:667– 673.
18. Trombelli L, Schincaglia G, Zangan F, et al. Effects of tetracycline HCl conditioning and fibrin-fibronectin

system application in the treatment of buccal gingival recession with guided tissue regeneration. *J Periodontol* 1995;66:313-320.

19. Dean JW, Chandrasekaran S, Tanzer ML. A biological role of the carbohydrate moieties of laminin. *J Biol Chem* 1990;265:12553-12562.
20. Wagle JE et al. Can application of exogenous fibronectin enhance periodontal regeneration? *J Clin Periodontol* 2002;29:440-447.
21. Komboli MG, Kodovazenitis GJ, Katsorhis TA. Comparative immunohistochemical study of the distribution of fibronectin in healthy and diseased root surfaces. *J Periodontol.* 2009;80:824-832.