

EFFECTS OF USING PROPOLIS IN PREVENTING RELAPSE IN ORTHODONTIC TREATMENT

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ARTICLE INFO

Article History:

received: 19/09/2023

revised: 06/11/2023

accepted: 09/12/2023

Keywords:

Propolis, relapse, orthodontics, fibroblast, osteoblast

DOI:

10.32509/mirshus.v3i2.55

ABSTRACT

Background: Relapse during orthodontic treatment often occurs. Herbal ingredients have many benefits, one of which is propolis extract which contains flavonoids, saponins and CAPE, which can increase the number of fibroblasts and osteoblasts in the traction area which play a role in bone remodeling, thereby preventing relapse during orthodontic treatment. **Purpose:** to find out more about herbal ingredients that can prevent relapse during orthodontic treatment. **Method:** analyzing research journals from the Google Scholar and Research Gate databases. The research analyzed was the effect of using the herbal ingredient propolis on tooth movement in preventing relapse in orthodontic treatment carried out on animals. **Conclusions:** This report reveals that the use of propolis at a certain concentration and in combination with HBOT can prevent relapse in orthodontic treatment by accelerating the formation of osteoblasts and fibroblasts.

INTRODUCTION

Orthodontic treatment is treatment in the field of dentistry which aims to correct malocclusion in the dentition.¹ The aim of orthodontic treatment is to straighten the position of the teeth in the correct arrangement and dental arch, in order to obtain efficient chewing function, facial harmony, oral tissue health, dentomaxillofacial aesthetics and stability of tooth position after treatment (Handayani, *et al.*, 2017).

When orthodontic pressure is applied to the teeth, the periodontal ligament which has fibroblasts, osteoblasts, osteoclasts and

cementoblasts will respond to mechanical forces and cause remodeling of the alveolar bone so that the teeth can move (Handayani, *et al.*, 2017; Brahmana *et al.*, 2018). Tooth movement resulting from the application of mechanical force by orthodontic tools has three phases, namely initial phase, lag phase and postlag phase (Amin *et al.*, 2017).

Tooth movement in orthodontic treatment is achieved through remodeling of the alveolar bone and periodontal tissue in response to mechanical forces (orthodontic forces) obtained from the activation of orthodontic appliance components that are applied to the teeth and transmitted to the tissue

surrounding the teeth including the gingiva, periodontal ligament and alveolar bone. Several types of orthodontic tooth movement consist of tipping, bodily, rotation, extrusion and intrusion, and torque (Amin *et al.*, 2017; Hikmah *et al.*, 2015).

The results of orthodontic treatment have a tendency to relapse, namely the return of teeth to their initial position after correction. Relapse is a problem in orthodontic treatment that still occurs frequently. Relapse is a response of the tooth supporting tissue due to the large force exerted on the tooth and can contribute to the stability of the occlusion and increase the mechanical stress exerted through the transseptal fiber system. The loss of pressure when the orthodontic appliance is removed will cause the teeth to begin moving back to their original position. Several factors can cause relapse, including inappropriate diagnosis and treatment, incomplete treatment, inappropriate retention devices, patients who are not cooperative in using retention devices, failure to eliminate etiological factors of malocclusion, failure to anticipate new pressures caused by changes. from the arrangement of the teeth, balance is not achieved in the oral cavity, and the retention period is too short, pull on the periodontal ligament, muscle pressure and bone adaptation. Therefore, after orthodontic treatment is completed, the results of the treatment need to be maintained so that they do not return to their original position by using retention devices (Utari *et al.*, 2023).

One way to stabilize teeth after orthodontic treatment is a retainer which aims to maintain the teeth in their new position after orthodontic treatment (Utari *et al.*, 2023).

The World Health Organization (WHO) defines traditional herbal medicines as natural ingredients derived from plants with little or no industrial processing (Majaz *et al.*, 2016).

One of the herbal ingredients that has been widely studied is propolis because it is known that propolis has been used as medicine for a long time. Research results show that propolis has several biological and pharmacological activities (Brahmanta *et al.*,

2018). Propolis is a honeycomb product that is rich in flavonoids. The flavonoid content in propolis can increase the number of fibroblasts in the traction area. Fibroblasts synthesize extracellular matrix proteins including fibronectin, glycosaminoglycans, and collagen structures which are the structural proteins of periodontal connective tissue (Handayani, *et al.*, 2017).

Apart from fibroblasts, propolis has an effect on increasing the number of osteoblasts in areas of tension during orthodontic tooth movement. The flavonoids found in propolis can also act as antioxidants. The effect of antioxidant therapy on bone metabolism is through inhibiting osteoclast activity and increasing osteoblast activity. Flavonoids play a role in the formation of new bone, by stimulating the maturation of osteoblasts (Brahmanta *et al.*, 2018).

METHOD

This writing was based on references obtained from journals, textbooks, accredited national journals, and websites accessed via Google Scholar, SciHub, ResearchGate and PubMed. The references referred to were selected based on analysis of relevant references, research, descriptives, and also literature studies from 2015 to 2022. The selected journals were seen from the inclusion criteria, including the use of propolis and the existence of experiments carried out using animals that had almost the same tooth morphology. with human teeth. From the search, six journals were obtained that met the inclusion criteria.

RESULT

The results found from the search database are shown in table 1 with a total of 7 references from the Google Scholar database. After being analyzed according to the inclusion criteria, 6 articles could be used and 1 article could not be used because it did not match the topic.

Referensi	Tujuan	Metode	Sampel	Hasil Penelitian
Handayani B et.al., (2017)	The Effect of Propolis Extract To Increase Fibroblast In Remodeling Process at Tension Side of Orthodontic Tooth Movement	After 14 days Cavia cobaya was sacrificed. Fibroblasts were examined using a light microscope using 400X magnification. The data obtained were analyzed using the ANOVA test and continued with the LSD test ($p=0.05$).	Thirty male Cavia cobaya divided into three groups. The first group, (P) was treated and given propolis extract gel. The second group K (+) was treated and given NaCMC gel. The third group, K (-) as a negative control.	The results of research using the ANOVA test showed that there were significant differences in the number of fibroblasts. On average, the highest number of fibroblasts was found in the propolis gel. The second group, because this group was given propolis ethanol extract gel for 14 days, which resulted in an increase in the number of fibroblasts which have the ability to form periodontal ligament, cementum and bone in areas of tension during orthodontic tooth movement.
Arya Brahmanta et.al., (2018)	Osteoblast Number in Tension Area by Giving Propolis Extract As Orthodontic Relaps Prevention	groups K- (without treatment), K+ (giving separator), P1 (giving separator and 3% propolis), P2 (giving separator and 5% propolis).	28 male guinea pigs were divided into 4 groups.	The results showed that there was an increase in the number of osteoblasts in the alveolar bone tension area in the K+, P1, P2 groups.
Rosiana Dewi Prayogo et.al., (2018)	Analyzing differences in the width of the periodontal ligament and the number of fibroblasts in the tension area with the administration of propolis gel and HBOT in an effort to prevent orthodontic relapse.	The upper left central incisor was extracted distally using a rubber separator 14 days in positive condition group; then the separating rubber was removed for 2 days to allow for relapse process. Data were analyzed using the LSD statistical test.	Forty-two male guinea pigs were randomly divided into 7 treatment groups, namely untreated group (I – negative group), group with rubber separator (II – positive group), 3% propolis gel treatment group (III), 5% propolis gel treatment group (IV), HBOT treatment group (V), combination 3% propolis gel and HBOT treatment	The results of the combination treatment of HBOT and 5% propolis gel showed significant differences in the width of the periodontal ligament and the number of fibroblasts compared to the other groups, while the HBOT group with a combination of 3%, 5% propolis gel and HBOT alone showed no significant differences in the width of the periodontal ligament.

			group, as well as a combination of 5% propolis gel and HBOT treatment group.	
Dandy Bayu Angkasa <i>et.al.</i> , (2019)	Analyzing the effect of a combination of 3%, 5% propolis for 14 days and HBOT 2.4 ATA 3x30 minutes at 5 minute intervals for 7 days on the diameter of blood vessels in the area of traction on the periodontal ligament to prevent relapse.	The randomized post test only control group design method was used in this research. 42 male guinea pigs (cavia cobaya) were divided into 7 groups: K- (No treatment), K+ (Giving separator), P1 (Giving separator and 3% propolis extract), P2 (Giving separator and 5% propolis extract), P3 (Giving separator and hyperbaric oxygen therapy), P4 (Administration of separator and combination of hyperbaric oxygen therapy, 3% propolis extract), and P5 (Administration of separator and combination of hyperbaric oxygen therapy, 5% propolis extract).	42 male guinea pigs (cavia cobaya) were divided into 7 groups.	The results of the combination treatment of HBOT and 5% propolis gel showed significant results in increasing the diameter of blood vessels in the area of tension in the periodontal ligament during tooth movement compared to the combination of HBOT and 3% propolis, HBOT alone, and 3% and 5% propolis therapy.
Mieke Sylvia Margaretha A R <i>et.al.</i> (2021)	The Effect of Apis mellifera Propolis on RUNX-2 and ALP during Remodeling of Orthodontic Tooth movement	Propolis is a resinous substance produced by bees. Cavia cobaya with orthodontic teeth movement with the separating rubber. The control group (Group 1) included clinically healthy 3% and 5% propolis (n=7), (Group 2) included Cavia cobaya with orthodontic tooth movement (n=7). Treatment group (Group P1) Cavia cobaya has been treated with orthodontic tooth movement and 3% propolis, (Group P2) Cavia cobaya has	Propolis extract 3% and 5% and Cavia cobaya.	The results showed that RUNX-2 and ALP were found to increase on the pulling side, indicating that propolis has the ability to remodel bone by increasing RUNX-2 and ALP in the pulling area during orthodontic tooth movement.

		was treated with orthodontic tooth movement and 5% propolis and observed for 17 days. Example of the upper jaw taken from subjects for analysis on day 17. Expression of RUNX-2 and ALP was evaluated using immunohistochemical staining.		
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TOOTH MOVEMENT

The initial phase of orthodontic tooth movement always involves an acute inflammatory response characterized by capillary vasodilation and migration of leukocytes into the capillaries. The acute inflammation that occurs is the initial phase and is exudative in nature. One to two days later, the acute inflammatory phase becomes chronic, proliferative inflammation involving fibroblasts, endothelial cells, osteoblasts and alveolar bone cells. During this period leukocytes continue to migrate to the paradental tissue and regulate the remodeling process. After the initial phase, there is a lag period where there is little or no tooth movement. The lag phase occurs due to the formation of hyalinized tissue in the periodontal ligament, which must be removed before tooth movement can progress further. The second phase in the pressure area is recognized by the appearance of an abnormal arrangement of periodontal ligament fibers. Disruption of blood flow due to this distortion will lead to the formation of areas of hyalinization and cessation of tooth movement. Furthermore, in the post lag phase, tooth movement gradually or suddenly increases and is usually visible after the initial 40 days of orthodontic force application. During tooth movement, the development and removal of necrotic tissue occurs continuously. During the post lag phase, osteoclasts form over a large surface area, directly absorbing the bone surface facing the periodontal ligament (Phulari *et al.*, 2017; Amin *et al.*, 2016; Pawinru *et al.*, 2021)

RELAPSE

Relapse in cases of orthodontic treatment according to Renfro is a return to the original form of malocclusion in whole or in part, or a tooth relationship that is different from the original malocclusion. There are many factors that can cause relapse, including inappropriate diagnosis and treatment, incomplete treatment, inappropriate retention devices, patients who are not cooperative in using retention devices, failing to eliminate etiological factors of malocclusion, failing to anticipate new forces that occur. caused by changes in the arrangement of the teeth, failure to achieve balance in the oral cavity, and retention periods that are too short, traction on the periodontal ligament, muscle stress and bone adaptation. Therefore, after orthodontic treatment is completed, the results of the treatment need to be maintained so that they do not return to their original position by using retention devices (Iswari *et al.*, 2012).

PROPOLIS

Propolis is a complex resin material collected by honey bees from buds and exudates from certain plant sources around the hive with varying colors and consistencies, collected by *Apis mellifera* bees from several plant sources. The word propolis comes from Greek; "Pro" means 'in defense, and "Polis" the city, namely the defense of the honeycomb (Fekry *et al.*, 2020).

Propolis is a honeycomb product that is rich in flavonoids. The flavonoids and caffeine

acid contained in propolis can also improve the immune system by increasing phagocytic activity, stimulating cellular immunity. Apart from that, flavonoids can increase immunity and reduce existing inflammation so that increased immunity can stimulate an increase in fibroblast growth factors and then result in an increase in fibroblasts (Handayani, *et al.*, 2017).

The chemical content of flavonoids in propolis is different from flavonoids from flowers because of the process carried out by bees. Flavonoids and (hydroxyl) cinnamic acid derivatives have been considered the main biologically active compounds in propolis. Saponin induces proliferation, differentiation and maturation of osteoblasts. Saponins activate TGF- β . Saponins increase TGF- β at fibroblast receptors. TGF- β will stimulate migration and proliferation of fibroblasts activities (Brahmanta *et al.*, 2018).

EFFECTS OF FLAVONOID CONTENT IN PROPOLIS TO PREVENT RELAPSE IN ORTHODONTIC TREATMENT

]Handayani *et.al.*, 2017, stated that propolis is a honeycomb product which is rich in flavonoids, has antibacterial and anti-inflammatory properties. Flavonoids derived from plants are also known to have anti-fungal, anti-viral and anti-oxidant properties. The flavonoids and caffeine acid contained in propolis can also improve the immune system by increasing phagocytic activity and stimulating cellular immunity. In the area of tension there is an increase in the number of fibroblasts, this occurs because of the flavonoid content in propolis. The flavonoid content in propolis can increase the number of fibroblasts in the traction area. Fibroblasts synthesize extracellular matrix proteins including fibronectin, glycosaminoglycans, and collagen structures which are the structural proteins of periodontal connective tissue (Handayani, *et al.*, 2017).

Arya Brahmanta *et.al* (2018) explained that propolis has an antioxidant therapeutic effect on bone metabolism, namely through inhibiting osteoclast activity and increasing

osteoblast activity. Flavonoids play a role in the formation of new bone, by stimulating the maturation of osteoblasts. Flavonoids play a role in the expression of osterix and RUNX-2, then stimulate osteoblast differentiation. In research by Arya Brahmanta *et.al* (2018), Rosiana Dewi Prayogo *et.al.* (2018), and Mieke Sylvia Margaretha *et al.*, (2021), stated that using 3% propolis extract gel provided significant results, especially using 5% extract gel which showed an increase in the number of fibroblasts and osteoblasts activities (Brahmanta *et al.*, 2018; Mieke *et al.*, 2021; Prayogo *et al.*, 2020).

DISCUSSION

Propolis is a honeycomb product that is rich in flavonoids. The flavonoid content in propolis can increase the number of fibroblasts in the traction area. Fibroblasts synthesize extracellular matrix proteins including fibronectin, glycosaminoglycans, and collagen structures which are the structural proteins of periodontal connective tissue (Handayani *et al.*, 2017).

Apart from fibroblasts, propolis has an effect on increasing the number of osteoblasts in areas of tension during orthodontic tooth movement. The flavonoids found in propolis can also act as antioxidants. The effect of antioxidant therapy on bone metabolism is through inhibiting osteoclast activity and increasing osteoblast activity. Flavonoids play a role in the formation of new bone, by stimulating the maturation of osteoblasts in areas of alveolar bone tension during orthodontic treatment to prevent relapse (Brahmanta *et al.*, 2018). Orthodontic treatment requires tooth movement. This movement requires pressure from the orthodontic device and space. When orthodontic pressure is applied to the teeth, the periodontal ligament which has fibroblasts, osteoblasts, osteoclasts and cementoblasts will respond to mechanical forces and cause apposition of the alveolar bone so that the teeth can move (Brahmanta *et al.*, 2018). After orthodontic treatment there is a possibility that the teeth will relapse or return to their original position, therefore Teeth that have

successfully moved to the desired position must be immediately maintained in the new position.

There was an increase in the use of 5% propolis extract. In Budi Handayani's research, the administration of 5% propolis extract significantly increased the number of fibroblasts in the traction area. The flavonoid content can increase immunity and reduce inflammation, so that increased immunity also stimulates an increase in fibroblast growth factors and then results in an increase in fibroblasts. Fibroblasts synthesize extracellular matrix proteins including fibronectin, glycosaminoglycans, and collagen structures which are the structural proteins of periodontal connective tissue. Fibroblasts have the ability to form periodontal ligament, cementum and bone (Amin *et al.*, 2017). In research conducted by Arya Brahmanta on administering 5% propolis extract, significant results were obtained in increasing the number of osteoblasts in the area of traction of the alveolar bone. The focus of propolis content used in this research is flavonoids, especially saponins, which function to induce proliferation, differentiation and maturation of osteoblasts. In the process of bone formation, osteoblasts will turn into osteocytes and some others will be on the periosteal or endosteal surface of the bone. Propolis contains flavonoids which act as antioxidants. Antioxidant therapy has been widely studied for its effects on bone metabolism through inhibiting osteoclast activity and increasing osteoblast activity. Flavonoids play a role in the formation of new bone, by stimulating the maturation of osteoblasts (Majaz *et al.*, 2016).

RUNX-2 plays a role in osteoblast maturation and new bone formation. Mieke Sylvia *et al.*, (2021) conducted research aimed at determining the effects of *Apis mellifera* propolis on RUNX-2 and ALP during orthodontic tooth movement remodeling. The expression of RUNX-2 and ALP was evaluated using immunohistochemical staining and the results showed that the expression of RUNX-2 and ALP was found to increase on the

stress side which indicates that propolis has the ability to remodel bone by increasing the expression of RUNX-2 and ALP in the stress area during orthodontic tooth movement. RUNX-2 together with other proteins interacts directly or indirectly with various molecules in bone remodeling to form a signaling network. CAPE has been shown to increase RUNX-2. The active ingredient CAPE has strong potential for antioxidant activity, anti-apoptotic effects, and modulation of RUNX-2 and RUNKL/OPG. The CAPE content in propolis can increase the expression of the ALP enzyme produced by osteoblasts during bone formation and growth (Mieke *et al.*, 2021).

Apart from that, there are two studies with significant results using a combination of 5% propolis extract and HBOT. Prayogo *et al.*, (2020) and Angkasa *et al.*, (2019) have the same research method by dividing research subjects into seven groups. The results of both studies obtained significant results with different assessment aspects. In Prayogo's (2020) research, the most effective results were obtained using a combination of 5% propolis with HBOT on periodontal ligaments and fibroblasts. This is because HBOT therapy which uses 100% oxygen at a pressure higher than atmospheric pressure can increase periodontal remodeling and there is fatty acid content in 5% propolis which can increase fibroblast cells which are the main cells in the periodontal ligament (Prayogo *et al.*, 2020). However, in the Angkasa research (2019) administration of 5% propolis and HBOT therapy also affects the dilation of blood vessels in the area of tension in the periodontal ligament during tooth movement. This is because HBOT therapy given systemically can increase fibroblasts to encourage vasodilation in areas of edema. Hyperbaric oxygen therapy increases the partial pressure of oxygen dissolved in the blood so that it can affect bone remodeling processes, angiogenesis, and blood supply. The flavonoid content in propolis can increase nitric oxide synthase activity in blood vessel endothelial cells and reduce inflammation, the bone remodeling process can run more quickly (Angkasa *et al.*, 2019). Propolis extract administration during the

use of orthodontic appliances will increase the formation of fibroblasts, osteoblasts and enlarge the diameter of blood vessels which plays a role in preventing relapse during orthodontic treatment.

CONCLUSION

Relapse remains a complex problem after orthodontic treatment, where alveolar bone remodeling is an important element in the occurrence of relapse. The results of this research prove that administration of propolis extract at a certain concentration or in combination with HBOT can have an effect in preventing relapse by increasing the number of osteoblasts and fibroblasts which are the main cells of the periodontal ligament and dilating blood vessels in the alveolar bone pull area in tooth relapse after orthodontic treatment.

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