

ISSN: 2087-8710

Proceeding Book

The Indonesian Journal of Dental Research

**Proceeding of
The International Symposium on Oral and
Dental Sciences**

**Current Clinical Approaches in The Prevention of
Caries and It's Implication
Advanced Clinical Approaches for The Prevention of
Dental Caries and Implicated Disease**

Royal Ambarrukmo Hotel
Yogyakarta, January 17th - 18th, 2013

The Effect of Curcuminoid to the Collagen Fibers Density of Osteoarthritis of Temporomandibular Joint

Dwi Merry Christmarini Robin

*Department of Oral Pathologic, Dentistry Faculty of Jember University
Jember, Indonesia
merrychristmarini@ymail.com*

Abstract

Introduction: Progressive degradation of articular cartilage is the underlying problem on osteoarthritis of temporomandibular joint. This degradation was related to destruction of the ground substance of extracellular matrix on articular cartilage i.e., decreases of collagen fibers density induced by increase of proteolytic enzyme, chondrocyte apoptosis, and cartilage degradation product that trigger inflammation process. Curcuminoid has antioxidant and anti inflammation activities which are capable on inhibiting cyclooxygenase in the same manner as non-steroidal anti inflammatory drug i.e., piroxicam. The aim of this study was to investigate the effect of curcuminoid on the collagen fibers density of temporomandibular cartilage of osteoarthritis-induced rats. **Materials and methods:** Sixty rats were randomly grouped into five groups in this research. Curcuminoid treatment given was 9 mg twice a day during 14 day. Osteoarthritis-induced rat without curcuminoid treatment was considered as negative control, meanwhile positive control group was composed by osteoarthritis-induced rat administered with piroxicam 20 mg per day, and control group was normal rats without any osteoarthritis induction. These treatments were administered after inducing osteoarthritis on rats by injection of Complete Freund's Adjuvant (CFA) on right side of temporomandibular joint. **Result:** This study result showed increasing average of collagen fibers density changes on cartilage of experimental rats, compared to negative control groups. In the other hand, curcuminoid groups and positive control groups did not show significantly different change ($p>0.05$). **Conclusion:** It can therefore be concluded that administration of curcuminoid will significantly increase the density of collagen fibers on temporomandibular joint cartilage of osteoarthritis-induced rats, equivalent to the activities of non-steroidal anti inflammatory drugs (NSAID), that is piroxicam.

Keywords: curcuminoid, osteoarthritis, temporomandibular joint, collagen fibers

Introduction

Osteoarthritis is one of the temporomandibular joint disorders characterized by inflammation [1]. Temporomandibular joint osteoarthritis is chronic, slowly-progressive, and characterized by thinning of joint cartilage and the presence of new bone formation (osteocytes) on the surface of joint [2]. Chemical and mechanical pathways of inflammation on temporomandibular joints stimulate inflammatory cells to secrete cytokines and growth factor mediators. Cytokine interleukin-1 (IL-1) and tumor necrosis factor (TNF) stimulate chondrocyte cells and synovial lining cells through nitric oxide (NO) stimulation allowing the cells to secrete proteolytic enzymes e.g. collagenase, stromelysin, and elastase which in turn damage joint cartilage [3]. Inflammation process in temporomandibular joint osteoarthritis also occurs

through the formation of prostaglandins by cyclooxygenase enzyme and free radical formation resulted from the process [4]. Joint cartilage damage induces release of proteoglycans, collagen, and hyaluronic acid in the synovial fluid of temporomandibular joint causing decrease of proteoglycans and collagen fibers levels on joint cartilage matrix [5].

Curcuminoids, an active substance contained in turmeric (including turmeric and ginger), is now widely studied and proved to have anti-inflammatory and antioxidant effects that are expected to be an alternative therapy in osteoarthritis treatment. Curcuminoids may inhibit the activity of IL-1 and TNF to the nucleus factor *kappa beta* (NF κ β), therefore it may reduce inflammation process [6]. In addition, curcuminoids may also functions as a sweeper against free radicals, which decreases serum nitric oxide in activated macrophages that may prevent cartilage damage. Curcuminoids also serves as an anti-inflammatory by inhibiting the metabolism of arachidonic acid through inhabitation of the cyclooxygenase and lipooxygenase enzymes [7].

The purpose of this study was to examine the effect of curcuminoids in inhibiting the progression of cartilage damage in temporomandibular joints osteoarthritis by increasing levels of proteoglycans and collagen fiber density on matrix of temporomandibular joint cartilage.

Materials and Methods

The subjects of the study were 60 male rats of *Sprague Dawley* strain weighing in average of 300g at the beginning of the study. Treatment accorded to each sample was curcuminoids administration with a dose of 9mg/0.2ml saline twice per day, while the duration of administration was 7 days and 14 days. Osteoarthritis-induced rats without curcuminoid treatment was considered as negative control, meanwhile positive controls groups were composed by osteoarthritis-induced rats administered with piroxicam 20 mg per day, and control group was a group of normal rats without any osteoarthritis induction . Osteoarthritis on rats was induced by injection of *Complete Freund's Adjuvant* (CFA) in intra-articular of right temporomandibular joint. Osteoarthritis occurred in less than 6 weeks after injection.

The analysis was conducted between control groups and treatment group, and among treatments. Measured parameter, resulted from the treatments applied, was density of collagen fibers. Collagen fibers density was measured from histological preparation using *Mallory* staining methods. Data obtained from collagen fibers density observation were analyzed with *Kruskal-Wallis and Mann-Whitney U Test* [8].

Results

Kruskal-Wallis test results on collagen fiber density observation data showed significantly different ($p < 0.05$) alteration of collagen fibers density on temporomandibular joint cartilage of rats between 7 days, 14 days and 21 days of treatment group, as well as between control and treatment group ($p < 0.05$). The results of Mann-Whitney U test on collagen fibers density change showed significant difference ($p < 0.05$) between 7 days and 21 days treatments and 14 days and 21 days treatment. However, there was no significant difference ($p > 0.05$) between 7 days and 14 days treatment. On the other hand, significant difference ($p < 0.05$) was found between control group (-) and all of control groups and treatment group. It showed no significant difference ($p > 0.05$) between normal and control group (+). However with curcuminoids, groups at all dose showed a significant difference ($p < 0.05$).

TABLE 1. THE MEAN AND STANDARD DEVIATION OF COLLAGEN FIBER DENSITY SCORE CHANGES ON RATS TEMPOROMANDIBULAR CARTILAGE

Description of Treatment	The Mean \pm Standard Deviation of Collagen Fiber Density Score Change			
	Control Groups			Treatment Group
	Normal	(Control -)	(Control +)	Curcuminoids 9mg
Day 0	2,8 \pm 0,44721	1,4 \pm 0,54772	2,4 \pm 0,54772	1,2 \pm 0,44721
Day 7	2,6 \pm 0,54772	1 \pm 0	2,2 \pm 1,30384	2,2 \pm 0,44721
Day 14	2,8 \pm 0,44721	1 \pm 0	3 \pm 0	2,8 \pm 0,44721

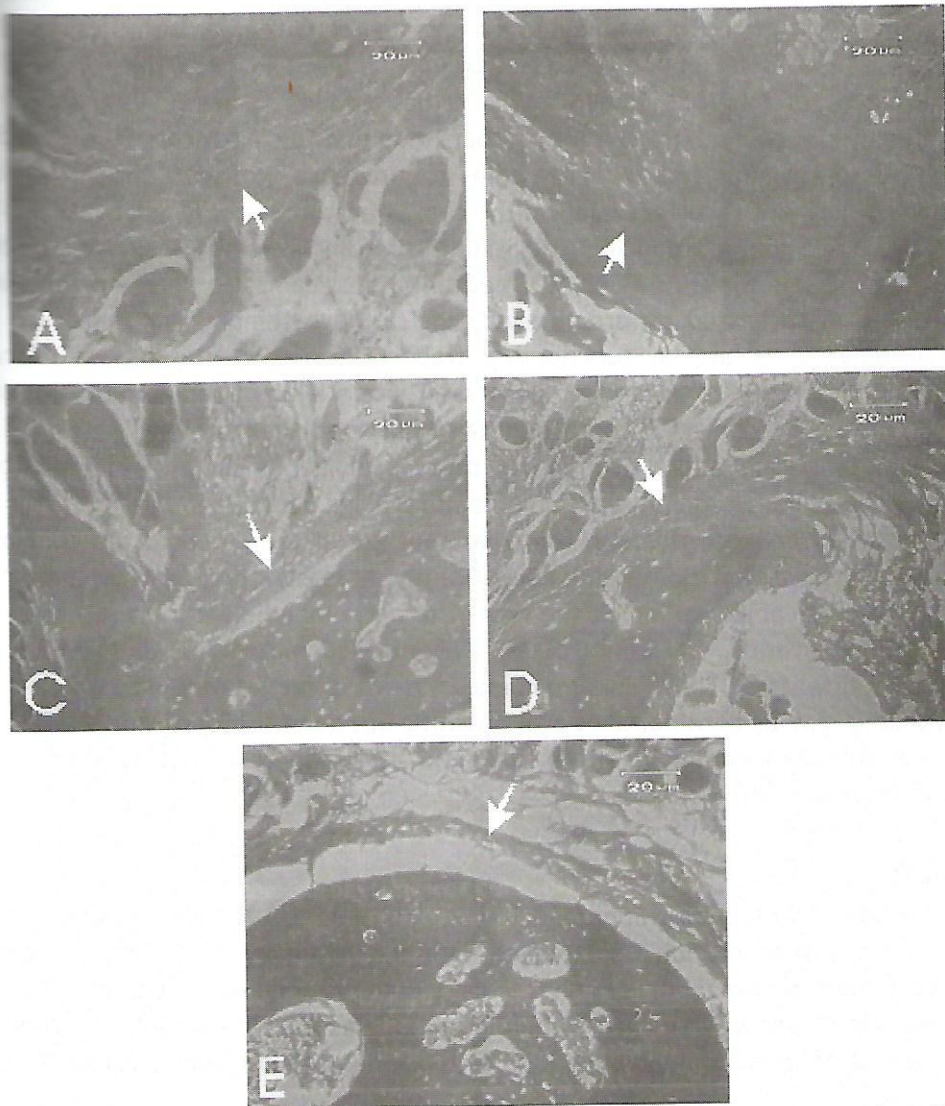


Figure 1. Histological description on rats' temporomandibular joints (200 x magnifications with *Mallory stain*) showed collagen fibers density changes on each treatment. Collagen fibers density on 9 mg curcuminoids group was similar to normal group, the control (+) indicated the highest density of collagen fibers. Collagen fibers in controls (-) seem to be very thin. Description: A. normal rats; B. Control (+); C. Curcuminoids group 9 mg day 7; D. Curcuminoids group 9 mg day 14; E. Control (-).

Discussion

This study result suggested curcuminoid significantly improve density score of collagen fibers on temporomandibular joint cartilage on osteoarthritis-induced rats compared to untreated one. It is caused by the activity of curcuminoids as cyclooxygenase inhibitors, lipooxygenase, and as primary and secondary antioxidants. Inflammation process in osteoarthritis occurs through the formation of prostaglandins. Inflammatory process results in cell damage that would release phospholipids. The phospholipase enzyme converts phospholipids to arachidonic acid (AA). Arachidonic acid is transformed through two channels, cyclooxygenase and lipooxygenase. In the cyclooxygenase pathway, AA is converted into prostaglandins, prostacyclin and thromboxane. In the lipooxygenase pathway, AA is changed to HETE, leukotrienes and SRSA. Both processes will release toxic oxygen radicals (Ox). Previous study reported topical application of curcumin on rats' ears may reduce arachidonic acid metabolism into 5-HETE by 83%, to 8-HETE by 85%, to PGE2 by 94%, and PGF2 by 92% [7].

Curcuminoids dose of 9mg/0.2ml saline twice a day applied for rats in this study was a minimum effective curcuminoids dose for osteoarthritis therapy. Piroxicam 20mg per day as a control (+) used in this study was able to increase collagen fibers density in temporomandibular joint cartilage significantly, compared to control (-) group. It was due to the ability of piroxicam in reducing the extent of joint cartilage damage by blocking cyclooxygenase enzyme. Besides as NSAID medicine, piroxicam also serves as antioxidants. Osteoarthritis is characterized by progressive joint cartilage thinning, accompanied by the formation of new bone at the subchondral trabeculae and at the edges of the joint (osteophytes) in which bone tissue possesses extracellular components undergoing calcification and ossification, thus more minerals contained than protein [9]. Some studies suggested that piroxicam and curcuminoids possess ability as an anti-inflammatory and antioxidant that may inhibit the progression of joint cartilage damage [9, 10]. Increased density of collagen fibers in the treatment group compared to the control group with curcuminoids piroxicam did not differ significantly. At least, it indicated curcuminoids and piroxicam have equal ability to inhibit the rate of temporomandibular joint cartilage damage induced by osteoarthritis. In some cases, uncontrolled piroxicam therapy can cause gastrointestinal disorders. Thus, curcuminoids is more effective and safer compared to piroxicam, then it may be considered as a therapeutic option of osteoarthritis. Additionally, in terms of economic, curcuminoids from turmeric and ginger extract relatively cheaper compared to piroxicam [4].

Conclusion

It can be concluded that administration of curcuminoids of 9mg/0.2ml saline twice a day for 14 days stimulate the regeneration of damaged cartilage tissue by increasing the density of collagen fibers in temporomandibular joint cartilage to the normal state osteoarthritis-induced rats. The study also showed that curcuminoids possesses an equal ability to piroxicam in inhibiting the rate of temporomandibular joint cartilage damage induced by osteoarthritis.

References

- [1] Olliff HS. 2003. Evaluation of a Frankincense-Tumeric Preparation for Managing Knee Osteoarthritis, *Herbal Gram. The Journal of The American Botanical Council*, 60: 20.
- [2] Price SA, Wilson LM. 1995. *Patofisiologi. Konsep Klinis Proses-proses Penyakit* 4th ed. EGC. Jakarta. 1218.