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SOD B® & Joint Pain Relief

Joint disorders are one of the most common disabling conditions worldwide: 60% of people aged of 65 and more have joint disorders. Without preventive appropriate approaches, joint alterations result in a decreased quality of life. Free radicals participate in structural and functional cartilage damages, including articular cell death and matrix degradation. These alterations are linked with decreased primary antioxidant defenses. Antioxidant and anti-inflammatory properties of Superoxide Dismutase (SOD) are scientifically backed in the management of joint disorders.

Free radicals & joint alterations

Cartilage cells, *i.e.* chondrocytes, display a metabolism adapted to anaerobic conditions. In response to partial oxygen pressure variations, chondrocytes produced abnormal levels of Reactive Oxygen Species (ROS) such as superoxide anions ($O_2^{\bullet -}$), and Reactive Nitrogen Species (RNS) including Nitric Oxide ($NO^{\bullet}$) and peroxinitrite ($ONOO^-$)[1]. These reactive species cause tissue damage by irreversibly altering macromolecules, including lipids and DNA. High local concentrations of ROS and RNS exert detrimental effects on chondrocyte functions, including inhibition of collagen and proteoglycan synthesis, activation of Matrix Metalloproteinases (MMPs) and inhibition of chondrocyte proliferation (Figure 1).

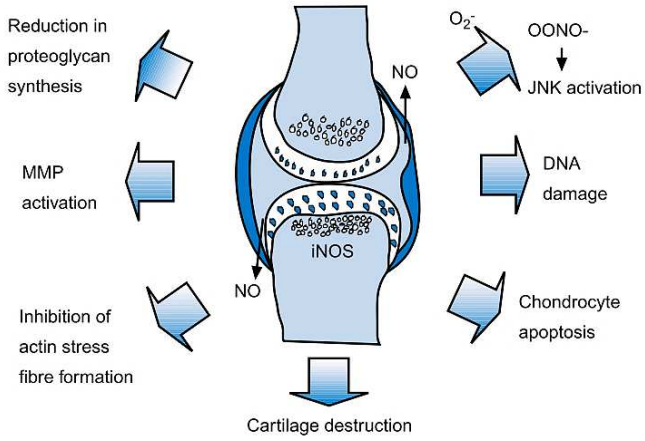

Figure 1: Implication of ROS and RNS in cartilage degradation[2].

Joint alterations & inflammation

Accumulation of inflammatory cells, particularly neutrophils, in the synovial fluid between joints is consistently observed in people with joint disorders. ROS, mainly $O_2^{\bullet -}$, formed in inflammatory processes by stimulated phagocytic cells, are highly reactive[3; 4]. Studies showed that $O_2^{\bullet -}$ degrade hyaluronic acid, collagen, and proteoglycans[5]. Excessive production of $O_2^{\bullet -}$ at the site of inflammation promotes the inflammatory process by inducing expression of pro-inflammatory cytokines.

Altered joints & antioxidant defenses

The overproduction of ROS observed in joint disorders is linked with lowered antioxidant defenses. In particular, all 3 major SODs in the cell are expressed at lower levels in altered cartilage compared to normal control cartilage, at both the messenger RNA and protein levels (Figure 2)[6].

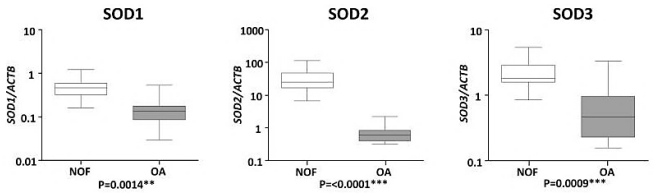

Figure 2: Comparison of SOD gene expression between cartilage from Neck Of Femur (NOF) and Osteoarthritis (OA) patients[6].

Further reports have showed a significant decrease in the activities of Catalase (CAT) and Glutathione Peroxidase (GPx), the two other antioxidant enzymes[7].

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SOD inhibits cartilage oxidation

SOD attenuates the cartilage destruction via two main mechanisms. First, SOD decreases $ONOO^-$ production thanks to the elimination of $O_2^{\bullet -}$ and the prevention of its reaction with $NO^\bullet$ (Figure 3).

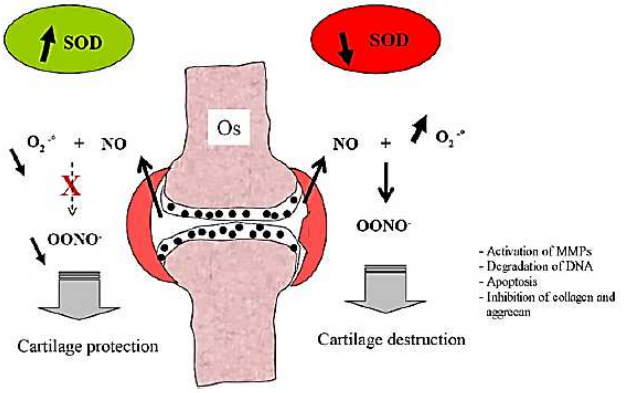

Figure 3: Protective effects of SOD on cartilage[3].

SOD inhibits Joint inflammation

Secondly, SOD, thanks to the elimination of $O_2^{\bullet -}$, contributes to decrease the influx of neutrophils to sites of inflammation. According to this way of action, the addition of SOD has been reported to decrease the expression of adhesion molecules and the release of pro-inflammatory cytokines (Figure 4)[3, 8].

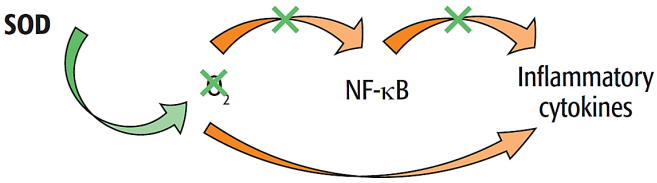

Figure 4: Anti-inflammatory action of SOD.

Numerous studies have confirmed the anti-inflammatory role of SOD by reporting its role in attenuating joint inflammation[3, 8].

SOD alleviates joint pain

The addition of SOD has been clinically demonstrated to reduce symptoms and pain associated with joint disorders[9-11]. Especially, SOD has been reported to increase grip strength and reduce morning stiffness[11].

The relief of symptoms is correlated with the improvement in biochemical and immunological variables in the synovial fluid. These results confirm the role of $O_2^{\bullet -}$ in the development of joint alterations.

SOD suppresses joint swelling

The SOD efficiency in correcting joint swelling has been shown by several reports. Local application of human SOD (1000 IU) given every 2 days has significantly reduced foot swelling in an *in vivo* model of adjuvant arthritis. In addition, an SOD overexpression in rats has been significantly reported to reduce joint swelling. Same results were obtained with the overexpression of both SOD & CAT[12]. These results confirm that the increase of endogenous sources of antioxidant enzymes provides a promising approach to the long-term suppression of joint inflammation.

SOD reduces bone damages

Local application of SOD (1000 IU every two days) has been demonstrated to attenuate bone damages associated with joint alterations in an *in vivo* model of arthritis[13].

Conclusion

Oxidative stress and inflammation are both involved in joint alterations. As a powerful antioxidant and anti-inflammatory agent, SOD has been reported to:

- **inhibit joint oxidation**
- **correct joint alteration**
- **alleviate joint pain**
- **suppress joint swelling**
- **reduce bone damages**

According to its unique way of action, SOD represents an efficient solution to correct joint alterations.

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