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POLIDEOXYRIBONUCLEOTIDE (PDRN): INNOVATIONS AND POTENTIAL IN TISSUE REGENERATION AND HEALING

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ABSTRACT

Research on polideoxyribonucleotide (PDRN) highlights its significant potential in tissue regeneration and healing, emphasizing its importance in the fields of dermatology and regenerative medicine. PDRN is a biopolymer derived from salmon sperm DNA, recognized for its properties that facilitate wound healing, as well as its synergistic interactions with exosomes. These small extracellular vesicles play a crucial role in intercellular communication, and their combination with PDRN enhances the release of growth factors and other bioactive molecules that promote regeneration. Systematic reviews and clinical studies have demonstrated the efficacy of PDRN in various conditions, including tendinopathies, skin lesions, and bone healing. Data indicate that PDRN is safe, with no adverse effects reported in the reviewed studies, which increases its viability as a therapeutic option. Continued research into the molecular mechanisms underlying PDRN's action is essential for standardizing dosages and treatment protocols, aiming to optimize its clinical applications. Furthermore, exploring combinations with other therapeutic agents and conducting multicenter studies are crucial for deepening the understanding of its effectiveness. In summary, PDRN represents an innovative and promising approach in the treatment of degenerative conditions and healing processes, signaling a positive future for regenerative medicine.

Keywords: Polideoxyribonucleotide (PDRN). Tissue Regeneration. Healing. Exosomes. Regenerative Medicine.

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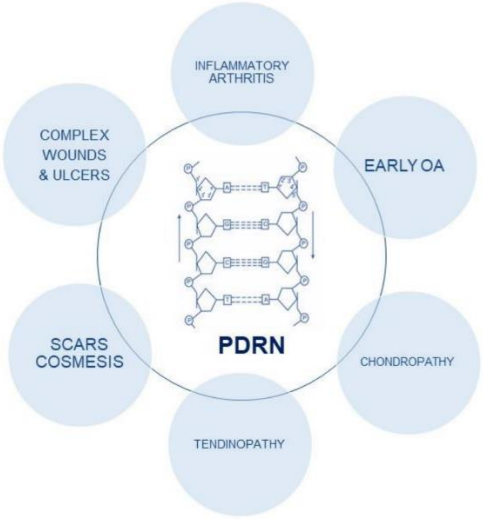
INTRODUCTION

Polydeoxyribonucleotide (PDRN) is a biopolymer extracted from salmon sperm DNA, gaining traction in regenerative medicine and dermatology due to its remarkable properties. It promotes wound healing, tissue regeneration, and possesses anti-inflammatory effects. The therapeutic benefits of PDRN primarily stem from its ability to stimulate cellular activities such as angiogenesis, fibroblast proliferation, and collagen production. This has led to its exploration for treating a range of conditions, including chronic wounds, signs of skin aging, and inflammatory skin disorders.

In contrast, exosomes are small extracellular vesicles crucial for intercellular communication, secreted by various cell types. They contain bioactive molecules, such as proteins, lipids, and nucleic acids, and are of considerable interest for their potential in drug delivery, biomarker identification, and therapeutic applications. Exosomes facilitate the transfer of genetic material and signaling molecules, influencing numerous biological processes, including immune responses and tissue repair.

The interplay between PDRN and exosomes represents a burgeoning research field. PDRN may enhance exosome release from cells, amplifying their regenerative capabilities. Evidence suggests that exosomes derived from PDRN-treated cells can carry growth factors and other bioactive compounds that further support tissue repair and regeneration. This synergistic effect could pave the way for innovative treatments for skin injuries, chronic wounds, and degenerative diseases.

Figure 1: PDRN structure and biological effects.



Source: Bizzoca et al. (2023).

A systematic review by Bizzoca et al. (2023) investigated the clinical efficacy of PDRN in managing tendon disorders, highlighting its status as a proprietary drug with diverse therapeutic advantages, including tissue repair and anti-inflammatory properties. The review synthesized data from a comprehensive search spanning January 2015 to November 2022, including nine studies (two in vivo and seven clinical), totaling 169 predominantly male patients. The results indicated that PDRN was effective and safe across various conditions, such as plantar fasciitis and chronic rotator cuff disease, with no reported adverse effects and significant improvements in clinical symptoms. The authors emphasized the need for multicentric randomized clinical trials to further elucidate PDRN's therapeutic role, especially in combination with other clinical protocols.

Veronesi et al. (2016) conducted a comprehensive review on PDRN's effects on musculoskeletal tissue regeneration, noting its low molecular weight and natural origin. PDRN was shown to stimulate cell migration, enhance extracellular matrix (ECM) protein production, and mitigate inflammation. While much research has focused on skin regeneration, this review examined the impact of PDRN on musculoskeletal tissues through a thorough analysis of studies published between 1990 and 2016. Out of 29 relevant studies, findings revealed that PDRN significantly promotes cell growth, tissue repair, and ECM production, while reducing pain and inflammation via adenosine A2A receptor activation. The review highlighted the variability in clinical dosages for musculoskeletal applications, advocating for further research to standardize dosing protocols for optimal tissue regeneration outcomes.

In a study by Colangelo, Galli, and Guizzardi (2020), the authors evaluated the molecular mechanisms behind PDRN's tissue regeneration properties. They conducted extensive database searches up to March 2020, identifying 34 eligible studies that encompassed in vitro, in vivo, and clinical assessments. The results indicated that PDRN effectively enhances physiological tissue repair through the activation of salvage pathways and the adenosine A2A receptor, significantly reducing healing time without adverse side effects.

Galeano et al. (2021) explored the intricacies of the normal wound healing process, emphasizing the interplay among various cell types and the roles of growth factors. They noted that conditions such as diabetes and ischemia can impair healing, characterized by hypoxia and decreased collagen synthesis. The study presented

PDRN as a promising therapeutic agent for enhancing wound healing, attributing its efficacy to its ability to stimulate cell migration, angiogenesis, and reduce inflammation in various impaired wound healing models. By reviewing literature from the last 25 years, Galeano et al. demonstrated PDRN's capacity to facilitate tissue repair and improve healing times.

Lastly, the scoping review by Manfredini et al. (2023) assessed the impact of PDRN on bone healing, synthesizing findings from recent in vitro and animal studies. The review included a variety of study types, narrowing down to eight relevant articles. The data indicated that PDRN significantly enhances bone healing and increases the volume of newly generated bone when used with grafting materials. However, the authors called for additional clinical studies to determine the optimal clinical applications and dosages of PDRN.

In a pivotal clinical trial by Kim et al. (2022), the effects of PDRN in preventing postoperative scars were evaluated for the first time. The study involved 44 patients undergoing open thyroidectomy, who were divided into PDRN treatment and control groups. Patients in the treatment group received two consecutive PDRN injections post-surgery. Three months later, various outcomes were assessed, revealing that those in the PDRN group had significantly lower modified Vancouver Scar Scale (mVSS) scores and vascularity subscores compared to the control group. Moreover, subjective symptoms and scar height were also notably reduced. With no specific side effects reported, the findings suggest that early postoperative PDRN administration is an effective and safe approach to preventing hypertrophic scars and improving overall scar outcomes.

The research surrounding polydeoxyribonucleotide (PDRN) reveals its significant potential in promoting tissue regeneration and enhancing healing processes, highlighting its relevance in various fields of medicine, particularly in dermatology and regenerative medicine. The reviewed studies demonstrate that PDRN not only facilitates wound healing but also acts synergistically with exosomes, amplifying regenerative effects through the release of growth factors and other bioactive molecules. The analysis of clinical trials, systematic reviews, and preclinical studies underscores the efficacy of PDRN in conditions such as tendinopathies, skin injuries, and bone healing, with safety and no reported adverse effects.

Continuing the investigation into the molecular mechanisms underlying PDRN, as well as standardizing dosages and treatment protocols, is crucial for optimizing its clinical applications. Moreover, exploring combinations with other therapeutic agents and delving into multicenter studies may enhance the understanding of its effectiveness. In summary, PDRN represents a promising therapeutic approach that could transform the treatment of degenerative conditions and healing, signaling a bright future for regenerative medicine.

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