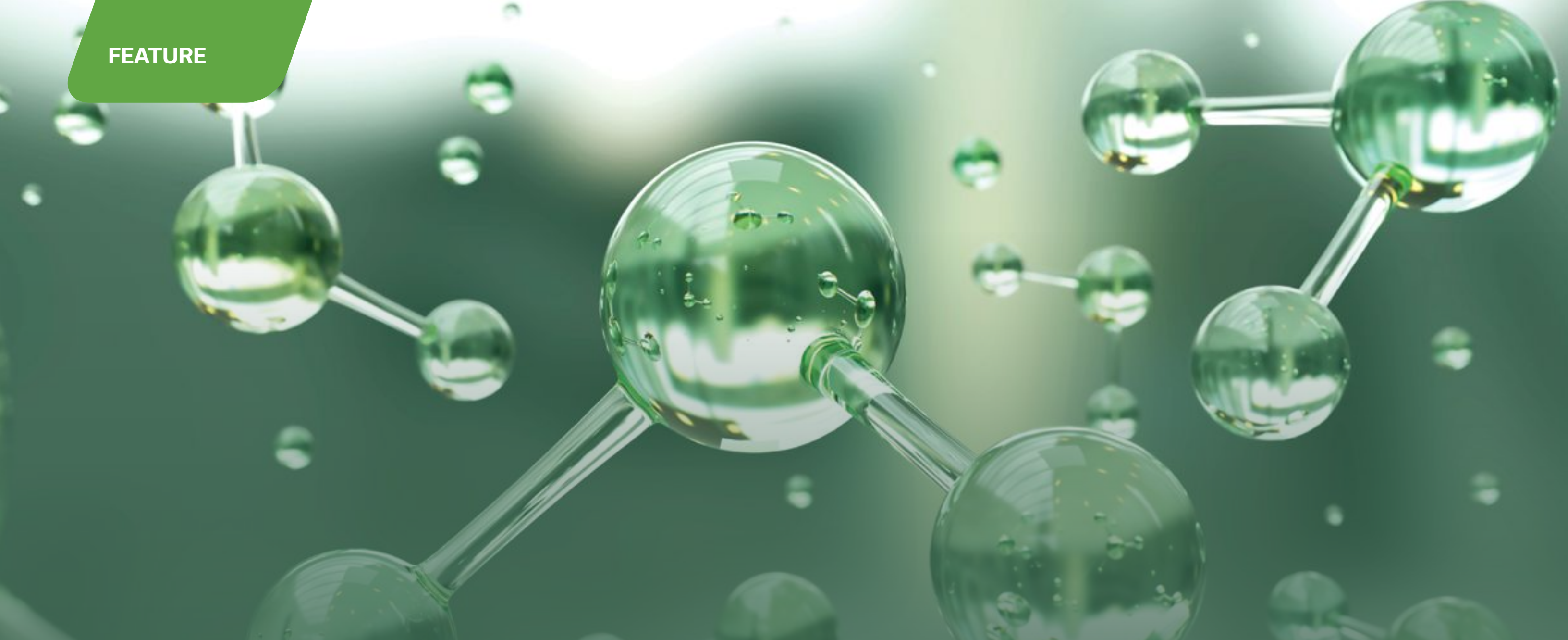

Exploring the Science and Potential of Nanotechnology in Hand Rehabilitation: A COMPREHENSIVE REVIEW

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Nanotechnology is the manipulation of matter on an atomic, molecular and supramolecular scale. Because of a variety of potential applications (including industrial, medical and military), governments have invested billions of dollars in nanotechnology research.[1]

Richard Feyman, American Physicist & Nobel Prize winner, delivered a famous speech, "There's Plenty of Room at the Bottom" at the California Institute of Technology (Caltech) in 1959. Feynman described the vision of using machines to construct smaller machines down to the molecular level. His speech is widely regarded as the first articulation of the concept of manipulating matter at the atomic and molecular scale. While Feynman's ideas helped to inspire the development of nanotechnology, Eric Drexler is credited with turning Feynman's theoretical concepts into a practical vision for the future of nanotechnology.[2]

Nanotechnology and Stem Cell Research

The combination of nanotechnology and stem cell research has shown great potential in the field of regenerative medicine and is the result of ongoing research and collaboration across multiple scientific fields.[3-7]

Photobiomodulation (PBM), also known as low-level laser therapy, involves the use of non-ionizing light sources to stimulate cellular function and has been shown to have a variety of beneficial effects on various tissues, including stem cells. Mitochondria are the powerhouses of the cell, and their proper functioning is crucial for the survival and proliferation of stem cells.

PBM may improve mitochondrial function in stem cells, leading to increased survival and proliferation and enhancing differentiation potential. PBM may also enhance the engraftment and integration of stem cells in transplanted tissues. This synergy between PBM and stem cell research lies in PBM's ability to improve survival, proliferation, differentiation potential and integration into host tissues of stem cells.[8-11]

This article traces the historical progress in stem cell, PBM and mitochondria research that led to the development of Lifewave phototherapy patches. These patches activate stem cells to accelerate wound healing, alleviate pain and reverse mitochondrial cell aging. They are effective for hand and upper extremity patients.

Nanotechnology Versus Pharmacology

Despite criticisms leveled against the Lifewave company for having inadequate methodology, small sample sizes and potential conflicts of interest, the clinical application of his Phototherapy patches and the unbiased patient results clearly demonstrate their potential significance in accelerating wound healing, reducing scarring and pain reduction. Therefore, it is imperative to objectively evaluate the efficacy of Phototherapy patches for patients who have not responded to traditional medicine or those who face severe side effects and risks associated with pharmaceutical treatments.

The Concept of Cell Longevity

While the media often promotes the idea of longevity through healthy lifestyle choices, they fail to acknowledge that aging is not determined by genetics, but rather a complex interplay of genetic, environmental and lifestyle factors. However, there are genes that maintain the biological functionality of an organism. These genes can influence factors such as DNA repair, cellular metabolism and the immune system, which can impact the rate of aging and overall health of an individual. What is known is that aging depends on cell longevity. Wound healing depends on cell longevity. Pain relief depends on cell functionality.[12-15]

Stem Cells

All organisms are made up of cells, and only four types of tissue cells, namely epithelial, connective, muscle and nervous, form the basis of all organs in animals. Each tissue cell has a different ability to undergo mitosis for self-replacement in case of damage or injury. Universal stem cells divide and differentiate into different groups of cells and become a specific cell type, such as a liver or muscle cell. Pluripotent stem cells are crucial in stem cell technology. Connective and epithelial cells have the greatest potential for tissue replacement, while nerve and tissue cells have the least ability for cell replacement. Persistent stem cells present in most tissues can differentiate into various types of cells to replace damaged tissue, but some tissues, such as nerve cells, inhibit persistent stem cells from dividing and replacing damaged cells.[16] Like every other cell, stem cells undergo aging, and their numbers decline with age due to the Hayflick limit (Figure 1).[17]

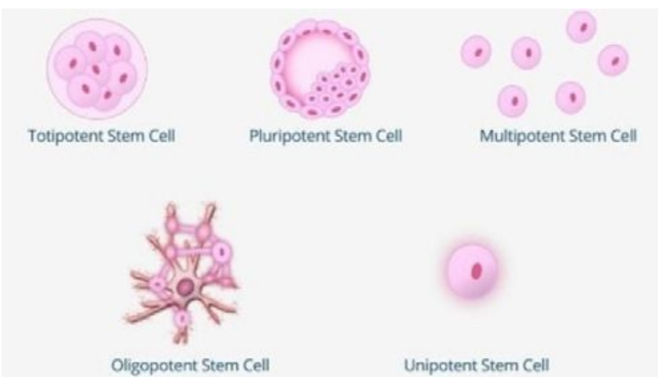

Figure 1. Types of stem cells

Stem Cell Pioneers

Leonard Hayflick

Leonard Hayflick is a well-known researcher in the field of aging and cell biology and was best known for his discovery of the mortality of human cell cultures or the Hayflick Limit.[17] The idea that telomeres, which cap the ends of DNA molecules, could act as a barrier to cell division, offered a potential explanation for the Hayflick Limit.

Hayflick emphasized that aging is the most significant risk factor for age-related illnesses, which has been largely neglected by researchers over the past five decades. He posits that the root cause of all age-related diseases lies in the molecular state of old or senescent cells, which are approaching the end of their lifespan. Understanding the molecular state at the nanoscale level and applying phototherapy to cells to enable them to act younger, holds the key to transforming the future of medicine.[17,18]

Andrea Bodnar

Andrea Bodnar's research at Gloucester Marine Genomics Institute focuses on telomeres and telomerase's roles in aging, cancer and neurodegeneration. Bodnar found that telomere growth prevents cell death, but as cells divide, telomeres shorten, reaching a critical length that triggers apoptosis. It is possible to extend cell division and rejuvenate cells by lengthening telomeres, potentially reversing aging and extending lifespan.[18] Furthermore, stem cell research offers the potential to replace damaged tissues and organs. Bodnar therefore emphasizes that research should focus more on the cell than on disease (Figure 2).

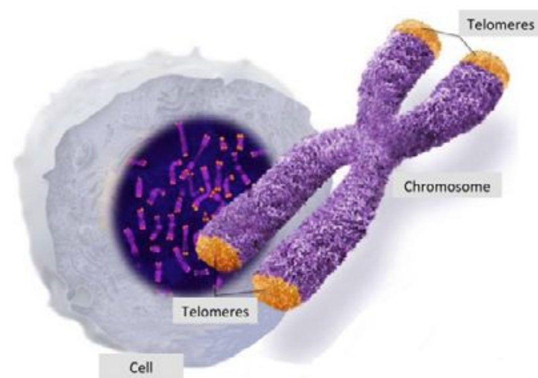

Figure 2. Telomeres

Bonghan Channels

Our bodies contain threadlike channels that correspond to traditional acupuncture meridians. These are called Bonghan Channels, which contain hyaluronic acid and chromosomal material highly reactive to stem cell antibody stains. When isolated, the chromosomal material grows into cells of all three germ layers. Acupuncture seems to stimulate these channels and thus the stem cells within the channels.[19] This finding offers credence to the efficacy of acupuncture, perhaps even to be considered as a form of stem cell activation therapy. This is important as Lifewave's technology works by placing the Phototherapy patches on the acupuncture meridians (Figure 3).

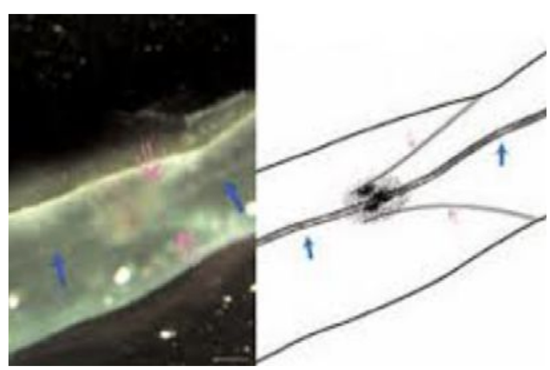

Figure 3. Bhongan Channels

The Importance of Copper

Copper is essential for creating energy within the body as it plays a crucial role in mitochondrial activity. Copper peptide (GHK-CU) was discovered in 1973 and has been shown to have various beneficial effects on skin health and increase the activity of mesenchymal stem cells.

Specifically, copper is required for the activity of cytochrome c oxidase. Without copper, cytochrome c oxidase cannot function properly, leading to a decrease in ATP production and impaired mitochondrial activity (Figure 4).[20]

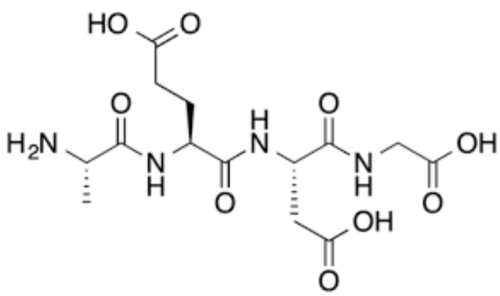

Figure 4. GHKCu

GHKCu can reset gene expression patterns to a more youthful state, potentially improving the health and function of various tissues and organs. Increasing GHKCu levels can lead to more stem cells becoming available for tissue healing in the body.[21]

Yamanaca Factors

Professor Shinya Yamanaka identified a group of four specific protein transcription factors that play a vital role in the creation of induced pluripotent stem cells, called iPSCs. He was awarded the Nobel Prize for Physiology or Medicine for the discovery that mature cells can be converted to stem cells through reverse programming. If you apply the Yamanaca factor, which is the signaling molecule to the skin stem cells, you can revert them to pluripotent stem cells.[22]

The Impact of Light on the Biochemical Changes in the Cell

Prof Michael Hamblin

The Wellman Center for Photomedicine's Principal Investigator is the world's foremost authority on Neuromodulation and photomedicine. He proposed that cellular chromophores are responsible for the effect of visible light on mammalian cells. His work has demonstrated the effectiveness of low-level light therapy in wound healing, pain management, and treating neurological disorders such as Alzheimer's and Parkinson's disease and has been instrumental in the development of the Lifewave patches (Figure 5).[23-25]

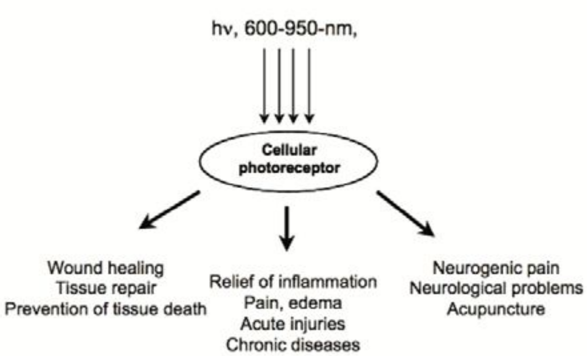

Figure 5. Low-level light influence on cellular photoreceptor

David Schmitt

David Schmitt developed Lifewave patches, which use low-level light therapy to stimulate the skin and increase the body's natural production of stem cells through GHKCu. This has been confirmed through double-blinded, placebo-controlled randomized controlled trials using blood, urine and bioelectrical tests.[26] The patches provide an affordable form of stem cell technology for hand and upper extremity patients.

The Mitochondria

Mitochondria are cellular power plants that produce energy for cells to reproduce. Sunlight can provide up to 30% of our body's energy. Copper and cytochrome c oxidase are essential in the electron transfer chain of mitochondria to generate ATP as seen in the Kreb's Cycle.[27,28] Stimulating the skin with light increases cytochrome c oxidase, which leads to increased cell proliferation, cytokine modulation and tissue oxygenation. This results in benefits such as increased wound healing, pain reduction and amelioration of damage after injury or toxicity (Figure 6).[29]

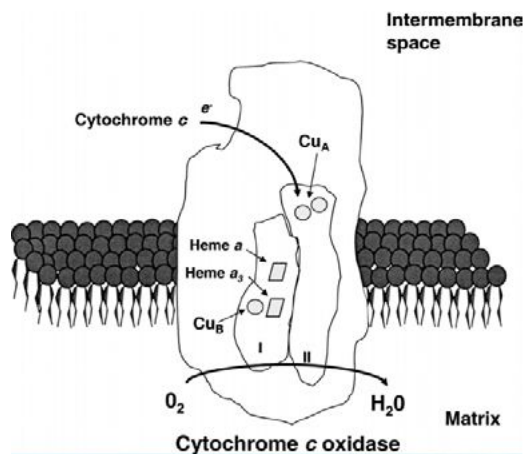

Figure 6. The Mitochondria Cell

Conclusion

Low-level light therapy stimulates cellular chromophores, including cytochrome c oxidase, in the mitochondria, resulting in increased ATP production and modulation of cellular functions. Copper and cytochrome c oxidase are critical components of energy production within the body. Copper peptides also have shown benefits for skin health and tissue repair. The combination of light therapy and copper peptides can increase stem cell production, aiding in tissue healing and regeneration. Products like Lifewave patches utilize this technology to provide affordable stem cell therapy. Overall, low-level light therapy has promising potential to improve various health conditions or injuries and remains an area of active research.

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