



# A REVIEW ON PHOTOTHERAPY

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## Abstract:

Phototherapy is the use of sun light or light from other sources for therapeutic purposes. It is conventionally used for treating several medical conditions like Psoriasis, Vitiligo, Atopic dermatitis, Lichen planus, Alopecia areata, Urticaria pigmentosa, Acne vulgaris and Neonatal jaundice etc. It involves the use of fluorescent light bulb, sunlight and light emitting diodes to treat above mentioned medical conditions. The phototherapy is being used since time unknown to treat different diseases but in modern era different techniques like PUVA, electric light bulb and electric generators and various other light sources are also being used. And it's gaining more importance in treating dermatologic disorders with non-infectious etiology. William Henry Goeckerman use phototherapy to treat Psoriasis in 1923. The phototherapy is not only suggested by modern physicians but also used by unani physicians for the purpose of treating different diseases. In this paper we are trying to explore some disease conditions in which phototherapy is being used for treatment purpose successfully.

**Keywords:** Electric bulb, Phototherapy, Psoralens, PUVA, Sunlight

## Introduction:

Phototherapy or light therapy or treatment with sunlight is used since ancient time to treat different skin disorders. It's a branch of photobiology which is an emerging science entity to study the effect of light on living beings.<sup>1</sup>

India has rich medical tradition which can be seen in various medical and religious treatise for example in Atharva veda it is mentioned in the treatment of leucoderma along with babchi seeds ingestion. Atrilalal an Egyptian drug i.e *Ammi majus* an oral drug along with sunlight exposure used for the treatment of vitiligo. It is mentioned by famous Arab physician named *Ibn e Baitar* in his voluminous treatise on herbal drugs named 'Mufradat e Adviya'. This treatment of leucoderma is also mentioned by modern scientists which is now termed as PUVA therapy a type of photo chemotherapy. Modern perspective suggests the use of chemicals called psoralens internally followed by the use of exposure to computer operated UVA panels. *Niels Ryberg Finsen* was known as father of phototherapy, he was aware about the fact of bacterial destruction with sunlight. He developed a lamp and with the help of that lamp he

treated 'Lupus Vulgaris' lesions found on his friends skin and observed that within few months the lesions subsided. Later on he also used this lamp over 800 patients with Lupus Vulgaris and results shows that about 80% were cured. For this achievement Finsen also awarded with Nobel Prize in dermatology or photo medicine<sup>2</sup>.

Various systems of medicines like Egyptian, Chinese and Ayurveda believe that sunlight have healing properties so they use sunlight for treating several diseases. The 'Ebers Papyrus' recorded the treatment of Vitiligo with sunlight exposure along with local application of drugs like *Ammi majus*<sup>3</sup>.

The phototherapy was accepted in modern era when *Downs* and *Blunt* reported that light inhibited the growth of fungus in test tube. The modern discoveries makes it possible to create artificial or modified light sources which are used in phototherapy. *Issac Newton* in 1642-1727 discover a phenomenon of splitting of light in to several basic colours using a prism. The splitted colours were seven in numbers and his discovery was called as colour wheel. The infra-red spectrum of the sun was discovered by *Friedman Wilhelm Herschel* in 1800, in 1801 *Johann Wilhelm Ritter* independently discover the Ultraviolet radiation. In twentieth century phototherapy was developed to use as treatment in Neonatal Jaundice in the late 1950's. Phototherapy was used to treat psoriasis by *William Henry Goeckerman* in 1923. But the improvement in phototherapy was observed when along with phototherapy 8-methoxypsoralen and 5-methoxypsoralen isolated from *Ammi Majus* was used and oral use of 8-methoxypsoralen was introduced for Psoriasis<sup>3</sup>.

Apart from skin diseases phototherapy is also used to treat neonatal jaundice by exposing the neonatal skin to different wavelengths of light to decrease bilirubin level. Phototherapy in case of neonatal jaundice decreases the number of exchange transfusion and bilirubin induced neurological dysfunction. During phototherapy the neonates are kept 30-40 cm away from light source. Child is exposed completely except for genitalia and eyes. Phototherapy works by converting the interstitial, subcutaneous and capillary bilirubin in to water soluble photoproducts after the oxidation of bilirubin. These water soluble photoproducts can be easily excreted from body without further metabolism by the liver<sup>4</sup>.

Different lamps, CFL (Compact Fluorescent) and LED (Light Emitting Diode) were used to treat different disease conditions<sup>5</sup>.

Several clinical studies proved the efficacy of phototherapy in cases of psoriasis which shows that phototherapy via using NB-UVB and PUVA is commonly used in case of mild to moderate psoriasis<sup>6</sup>.

There are different light forms are available which shows beneficial effect in diseased persons. As we know light has wide spectrum of light infrared, ultra violet and visible spectrum. Therapeutic efficacy is seen in its UV spectrum although possible hazards are there. Conventionally UV spectrum is divided broadly into three types according to their wavelengths by Commission Internationale de l'Eclairage (CIE) as follows UVC (200–280 nm). UVB (290–315 nm). UVA (315–400 nm).<sup>1</sup> and UVA1 (340-400 nm) and UVA II (320-340nm). The mid day light have 10% UVB and 90% UVA<sup>7</sup>. It is found that the wavelength which reach effectively and absorbed by the DNA is around 313 nm, which is included in the UVB spectrum<sup>8</sup>. Although UV light penetration depends on various factors such as skin thickness and melanin pigments<sup>9</sup>. Now a days several diseases are being treated by light therapy and its use is not limited to vitiligo or psoriasis alone. The light therapies which are used are natural sunlight, NB-UVB, UVA, UVA1, cold-light UVA1, UVA and UVB, UVAB, Full spectrum light, Saltwater bath plus UVB (balneophototherapy), coal tar plus UVB radiation (Goeckerman regimen) and Psoralen plus UVA (PUVA)<sup>10</sup>.

**Methodology:**

The classical literature, authentic publications were analysed. The historical aspect of phototherapy and information regarding electromagnetic spectrum, their wave length and their role in various diseases were taken from various published papers and from some books. The data collected were compiled here for better understanding of phototherapy.

*Light and electromagnetic spectrum:*

Light is essential for life which contributes for sustenance and also for quality of life. Light can be defined as electromagnetic radiation with wave length lies in between 10nm and 1mm. Sometime word light can be used as synonym for electromagnetic radiation which includes ultraviolet radiation, visible, infrared regions, X-rays and gamma-rays and radio rays.

The electromagnetic spectrum is defined as the graphical representation of electromagnetic waves according to their wave lengths<sup>11</sup>. The light of different colours have different wavelength like violet (400-430 nm), blue (430-480 nm), green (480-560 nm), yellow (560-590 nm), orange (590-620 nm) and red (620-700 nm)<sup>11</sup>.

*Role of phototherapy (UV rays) in cases of psoriasis:*

Ultraviolet radiations either emitted from natural source or from any ambient source, is considered carcinogenic. Different wavelength of UV radiation exert different biological action through different mechanism. The UV ranges from 280 to 320 nm are UVB and from 320 to 400 nm are UVA. Despite of long term adverse effect of UV radiation it is widely used in cases of different skin disorders include psoriasis, atopic dermatitis, mycosis, and vitiligo. The UVA in combination with oral photosensitizer 8-methoxypsoralen (photo-chemotherapy, PUVA) leads to insert photosensitizer in the double helix DNA, which results in the development of highly mutagenic DNA-distorting photoproduct. Along with mutagenic effect UV radiation also exhibit immunosuppressive effects<sup>12</sup>.

UV phototherapy is a popular treatment regimen for psoriasis. Both broadband (290-320 nm) and narrowband (311 nm) were used for treating this stub born disease. The BB-UVB was first developed, and later on it is replaced by NB-UVB because of their more effectiveness. If we compare both BB-UVB and NB-UVB it shows that NB-UVB is more effective in clearing the psoriatic lesions. Its therapeutic application involves dosing three times per week at least for 3 months. In one of a randomized double blind study comparison is done in between high and low doses of NB-UVB radiations in psoriatic patients which reveals that both have comparable clearance rate, but high dose radiation prolongs the remission with minimum session of treatments. In order to improve its efficacy it can be combined with topical applications includes emollients, calcipotriene and coal tar.

Phototherapy shows remarkable effects in treating psoriasis but their mechanism of action is not well understood till date. Though studies shows that it induced apoptosis of pathogenic T-cells and keratinocytes and also local and systemic immunosuppression.

The inflammatory mediators like IL-6, IL-17 and TNF-alpha plays an important role in the pathogenesis of psoriasis but their marked reduction was observed in patient's peripheral blood followed this treatment.

PUVA either alone or in combination with topical application can be used as an alternative as both PUVA and NB-UVB are effective therapies for treating psoriasis but first line of choice is NB-UVB. The PUVA and NB-UVB can be applied in paediatric psoriasis if children is mentally and psychologically able to except and tolerate the treatment<sup>13</sup>.



*Role of Phototherapy in cases of vitiligo:*

This mode of treatment is being used for over 2500 years and still it is the mainstay of treatment although source of light and modes of application have changed during course of time. Photo-chemotherapy with psoralen compounds and subsequent exposure to UVA radiation is commonly termed as PUVA therapy.

Topical PUVA therapy is effective in vitiligo but it is a prolonged therapy which require almost 100-300 exposure to achieve maximum re-pigmentation and it is also observed that very few patient achieve complete re-pigmentation.

Oral PUVA therapy provides most consistent result with lowest risk and in this method methoxy psoralen is given orally in a dose of 0.4mg/kg body weight at-least 1-2 hours prior to exposure to UVA. The exposure to UVA may be applied to whole body or to the affected area with starting dose of 1joule/cm<sup>2</sup> and later on dose is increased slowly until a light pink colour is appeared over affected region. At least 2-3 exposure are given per week and these exposures must be 48 hours apart. Such types of patients who are under PUVA treatment must avoid sun exposure from the time of ingestion of psoralen.

Topical PUVA therapy is another way of achieving re-pigmentation and in this method Methoxy psoralen used in a concentration of 0.1% topically. The various lotions containing Methoxy psoralen is applied to affected region at-least 30-60 minute prior UVA exposure and initial UVA exposure dose is 0.25joule/cm<sup>2</sup>. After this mode of treatment the sun exposure must be avoided for remainder of the day and two treatments must be 72 hours apart<sup>14</sup>.

*Role of phototherapy in case of atopic dermatitis:*

Atopic dermatitis is a common skin inflammatory disorder that can affect almost all age groups. Various topical and systemic treatments are available to combat with this condition but some time these treatments fail to control the disease therefore at that time phototherapy can be used as a second option for the treatment of atopic dermatitis. In 1948 Nexman documented the beneficial role of phototherapy in atopic dermatitis and 30 years later, Morison published the report over role of Phototherapy in atopic dermatitis. Morison documented that oral Psoralen along with UV radiation could be used for successful treatment of atopic dermatitis. If we looked at the mechanism of UV rays in controlling atopic dermatitis then it showed that effect of phototherapy is multi-factorial. It targets the inflammatory cells of skin, induce positive immunosuppressive effects, altering cytokine production, inducing apoptosis of infiltrating T-cells and also by inhibiting the antigen presenting function of Langerhans cells. UV radiation protect the skin by inducing thickening of stratum corneum which in turns limit the entry of external agents. Besides this anti-bacterial effect of UV radiation prevent or reduced the colonization of staphylococcus aureus and pityrosporum orbiculare<sup>10</sup>.

*Role of phototherapy in case of acne vulgaris:*

Acne vulgaris is a chronic inflammatory disorder of pilo-sebaceous unit which almost affect 85% of adolescents. But sometimes it may also persist up to adulthood. Intense pulsed light (IPL) which is found to be effective in cases of acne scar treatment. Its mechanism of action is not known till date but it is observed by some dermatologists that it targets vascular proliferation which causes collagen overgrowth.

A newer therapy termed Radiofrequency (RF) is used initially for skin rejuvenation. In this method electromagnetic radiation produce an electric current that heats the dermis and causes skin contraction and neo-collagenogenesis<sup>15</sup>.

Blue light having a wave length 400-420nm, and therapy with this blue light having anti-bacterial activity against propionibacterium acnes exposure to blue light causes photo-excitation of bacterial porphyrins that leads to the destruction of bacteria<sup>16</sup>.

### Discussion:

Scientists consider UV light hazardous for skin as they cause cancers. Cataracts are also reported after PUVA<sup>17</sup>. Various other hazards are also reported like photoageing, mitochondrial damage and collagen destruction<sup>1</sup>.

Various less severe side effects like lentigenes, erythema, xerosis and pruritus are also common. These side effects usually aggravate after giving psoralens<sup>17</sup>.

### Conclusion:

After going through various sources it is observed that phototherapy has been proven a good option for the treatment of various skin as well as other diseases. This therapy is being used from ancient age to treat various skin diseases like vitiligo and psoriasis. Some time it is used alone and some time with oral ingestion of psoralen derivatives like 8-MOP. Recent advances in techniques and machinery makes it easy to use as one can also continue this therapy even at home with lesser adverse effects. So it's better time to explore out the hidden potentials of this therapy. Besides this it's also must to take necessary precautions while using to avoid hazards and to minimize the detrimental effects of phototherapy. For that dermatologists and physicists must collaborate and evaluate newer and safe methods of phototherapy to overcome the burden of skin disorders.

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