

# Assessment of the effectiveness of photobiomodulation therapy on humeroscapular periarthritis by diffuse reflectance spectrometry

Mihaela Antonina CALIN<sup>1</sup>, Constantin MUNTEANU<sup>2,3</sup>, Laura Madalina CURSARU<sup>4</sup>, Sorin Viorel PARASCA<sup>5</sup>  
Corresponding author: Mihaela Antonina CALIN, E-mail: [micalin@inoe.ro](mailto:micalin@inoe.ro)

<sup>1</sup>National Institute of Research and Development for Optoelectronics INOE 2000<sup>®</sup>, Magurele, Romania, <sup>2</sup>Romanian Association of Balneology, <sup>3</sup>Clinical Emergency Hospital "Bagdasar-Arseni", Bucharest, Romania, <sup>4</sup>National R&D Institute for Non-Ferrous and Rare Metals, INCDMNR-IMNR, Pantelimon, Romania, <sup>5</sup>Carol Davila University of Medicine and Pharmacy, Bucharest, Romania

**INTRODUCTION:** Humeroscapular periarthritis is an inflammatory illness of the soft tissue surrounding the shoulder joint which can lead to significant impairment of the upper limb function. The conservative treatment consists of oral anti-inflammatory drugs and kinesitherapy. As an alternative method, photobiomodulation therapy, widely used for the treatment of various musculoskeletal disorders, has also been recommended for the treatment of humeroscapular periarthritis. The purpose of this study was to investigate the efficacy of photobiomodulation therapy in the treatment of humeroscapular periarthritis.

**MATERIALS & METHODS:** Seven patients diagnosed with humeroscapular periarthritis were included in this study. Each patient received photobiomodulation therapy using a diode laser system (635 nm, 15 mW). The power density was 16.31 W/cm<sup>2</sup> and the exposure time was set at 240 s. The procedure was applied daily for 3 consecutive days. The effect of photobiomodulation therapy was evaluated based on changes in the optical properties of the affected area measured before and after each therapeutic session using diffuse reflectance spectrometry.

**RESULTS:** The results demonstrated that, after each laser irradiation session, photobiomodulation therapy induced an increase in diffuse reflectance of the affected shoulder. The stabilization of the diffuse reflectance values towards values close to those of normal tissues was noted after the third laser irradiation session when the reflectance values fell between (57-68) %.

**CONCLUSIONS:** In conclusion, the effectiveness of photobiomodulation therapy in the treatment of humeroscapular periarthritis was quantitatively demonstrated based on variations of the measured values of the diffuse reflectance of treated tissues, proving it to be a therapeutic option for this pathology

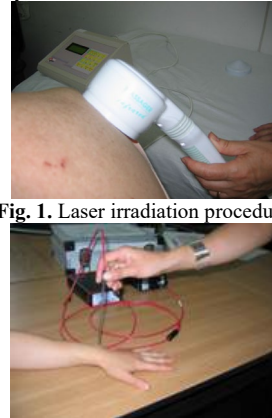



Fig. 1. Laser irradiation procedure

Fig. 2. The experimental setup for diffuse reflectance measurement

I. DATE CLINICO - EPIDEMIOLOGICE (Date personale)	
Nume	xxxxxx
Sex	feminin
Varsta	65 ani
Greutate	72 kg

II. DIAGNOSTICUL ANTERIOR SI ACTUAL
Poliartita reumatoida bilaterala

IV. PROCEDURA DE IRADIERE LASER	
Parametri laser	
Lungime de unda	635 nm
Densitatea de energie	
Puterea	15 mW
Mod de emisie	in continuu
Frecventa impulsurilor	-
Durata impulsului	-
Timpul de iradiere	240 s
Schema de iradiere laser	
Zona de iradiere	iradierea zonala 
Frecventa sesiunilor de iradiere tratament	1 sesiune / zi
Nr. total de sesiuni de iradiere	3 sesiuni

V. METODE DE EVALUARE A TRATAMENTULUI
Spectrometrie de reflexie difuza

Fig. 3. Treatment protocol

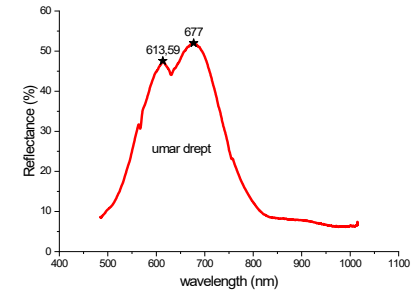


Fig. 3. The diffuse reflection spectrum of the affected shoulder. The spectrum shows 2 maxima located at  $\lambda_{1max} = 613,59$  nm ( $R_1 = 47,559$  %) si  $\lambda_{2max} = 677$  nm ( $R_2 = 52,008$  %) and a minimum located at  $\lambda_{1min} = 630,74$  nm ( $R_{min} = 44,054$  %)

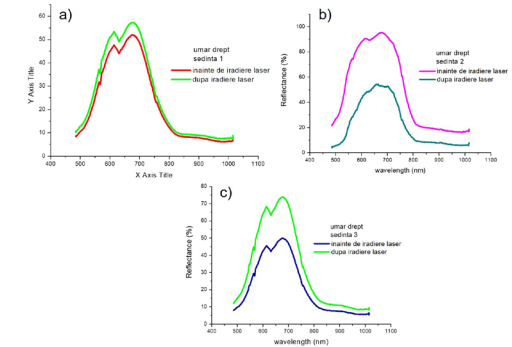


Fig 4. Variation of the diffuse reflectance of the affected shoulder during PBM therapy. a) the first treatment session; b) the second treatment session; c) the third treatment session

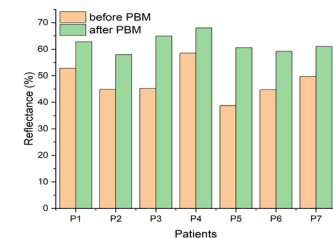


Fig. 5. Diffuse reflectance levels in individual patients who received PBM for 3 days