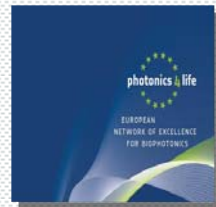


Monte Carlo simulation of light delivery from skin surface to maxillary sinus at laser treatment of sinusitis

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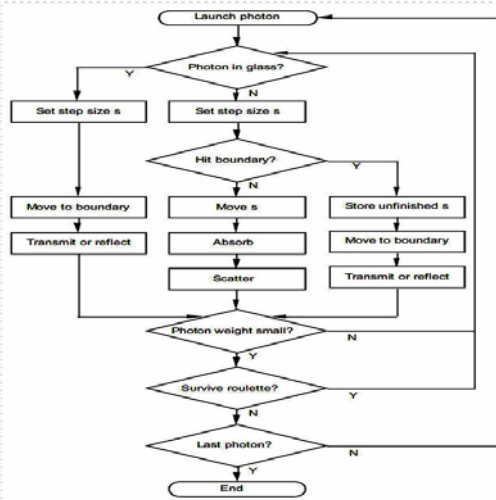


At the present stage of development of medicine non-drug methods of treatment of a sinusitis have got the greatest distribution. Laser therapy is considered as one of the most popular. Along with main benefits of this method, there is a problem of a choice of a required dose for treatment. The optimum decision of this problem is the method Monte-Carlo, which allows to describe process of propagation of light in object

Sinusitis is inflammation of the paranasal sinuses, which may be due to infection, allergy or autoimmune issues. Treatment of sinusitis are currently represents one of the most important tasks of modern otorhinolaryngology. According to several studies over the past decade, the incidence per 1000 population with chronic sinusitis has increased almost three fold, and the proportion hospitalized for diseases of the nose and sinuses is increased annually by 1.5-2 times. Sinusitis, rhinitis and maxillary sinuses are in the first place in frequency of diseases.

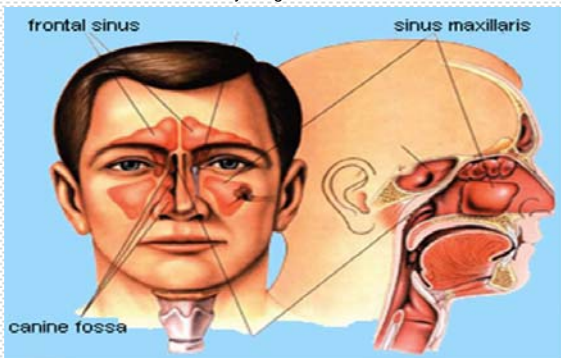
Methods

The main idea of a method is the account of the phenomena of absorption and dispersion on all optical way of a photon through the opaque environment. Distance between two collisions gets out of a logarithmic distribution, using a random number generated by computer. For the absorption account of each photon is assigned weight, and propagation through a enviroment this weight constantly decreases. If the dispersion has place, a new direction of distribution should be taken in conformity with phase function and other random number. This procedure proceeds until the photon does not leave the considered volume or its weight will not reach a certain magnitude. Monte Carlo method consists of five basic steps: generation of the photon source, the trajectory generation, absorption, liquidation, and registration. Let us briefly consider each of them



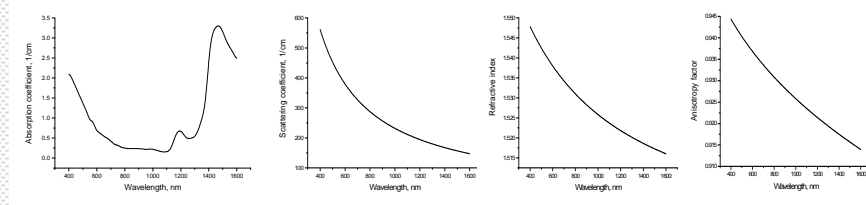
Flowchart for Monte Carlo simulation

Geometry of light irradiation

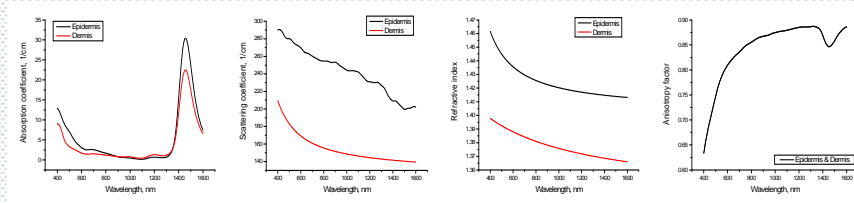


- Irradiation of maxillary sinus:
- Through skin
 - Through canine fossa
- Irradiation of frontal sinus

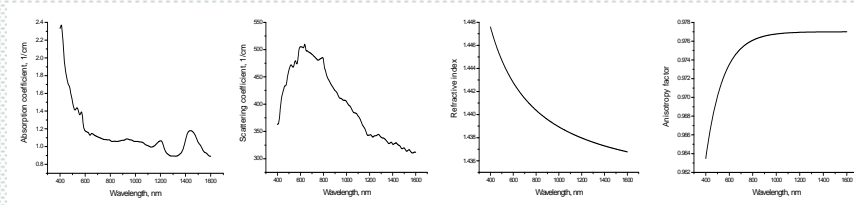
Optical properties: bone



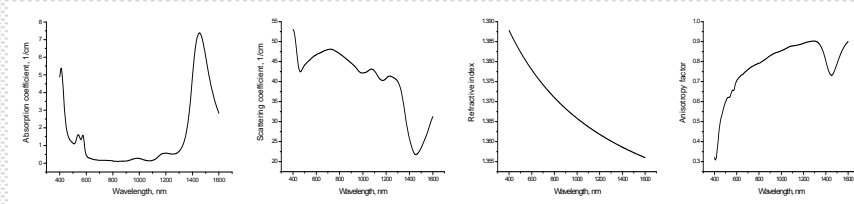
Optical properties: skin



Optical properties: adipose tissue



Optical properties: mucous tissue



Optical model

Irradiation of maxillary sinus through skin		Irradiation of maxillary sinus through canine fossa		Irradiation of frontal sinus	
Layer	Thickness	Layer	Thickness	Layer	Thickness
Skin	1-1.5 mm	Mucosa	0.1-1 mm	Skin	1 mm
Adipose	0.5-1 cm	Bone	0.1-1 mm	Adipose	2-3 mm
Bone	0.1-1 mm	Mucosa	0.1-1 mm	Bone	1-4 mm
Mucosa	0.1-1 mm				

Acknowledgments

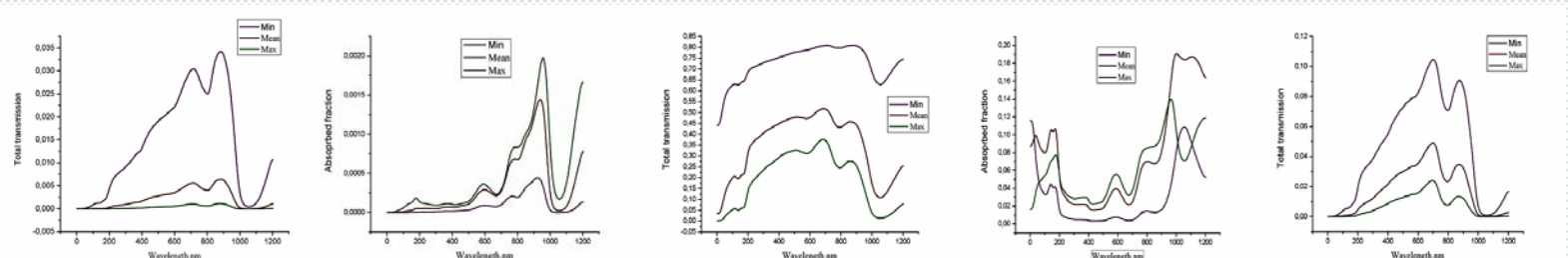
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Results

Irradiation of maxillary sinus through skin

Irradiation of maxillary sinus through canine fossa

Irradiation of frontal sinus



Min – total thickness 6.2 mm
Mean – total thickness 9.7 mm
Max – total thickness 13 mm

Absorbed fraction of light in mucous layer

Min=6,2mm
Mean=9,7mm
Max=13mm

The Absorbed fraction spectrum mucous

Min=4mm
Mean=6mm
Max=8mm