

Dosimetric Analysis of High Dose Rate Brachytherapy by Radiochromic Film

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Introduction

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Brachytherapy is an efficient cancer treatment that performs on direct contact with the affected area. According to the dose rate, it can be classified on LDR or HDR. In this last case, the treatment is made by some specific delivery and collecting equipments of the radiation source that are monitored by operators.



Introduction

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The radiochromic film is used on the dosimetry of brachytherapy treatments process. It's chemistry composition and density are very approximate to the human tissue, featuring it as an equivalent tissue. On this work, it was used the EBT2 Gafchromic Film produced by ISP - International Speciality Products.



Introduction

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The Microtek scanner is used at the radiochromic film dosimetry. Also classified as an RGB scanner, it performs the material reading at the three color channels red, green and blue of the visible spectrum as it is known. Moreover, as it is also classified as an transmission scanner, it is capable of maintain influent properties to dosimetry after the image digitalization.



Introduction

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Optical Density (O.D) refers to the absorbance property, which consists of the materials inherent capacity to absorb radiation on a specific frequency, in this work the visible light spectrum transmitted by the film.

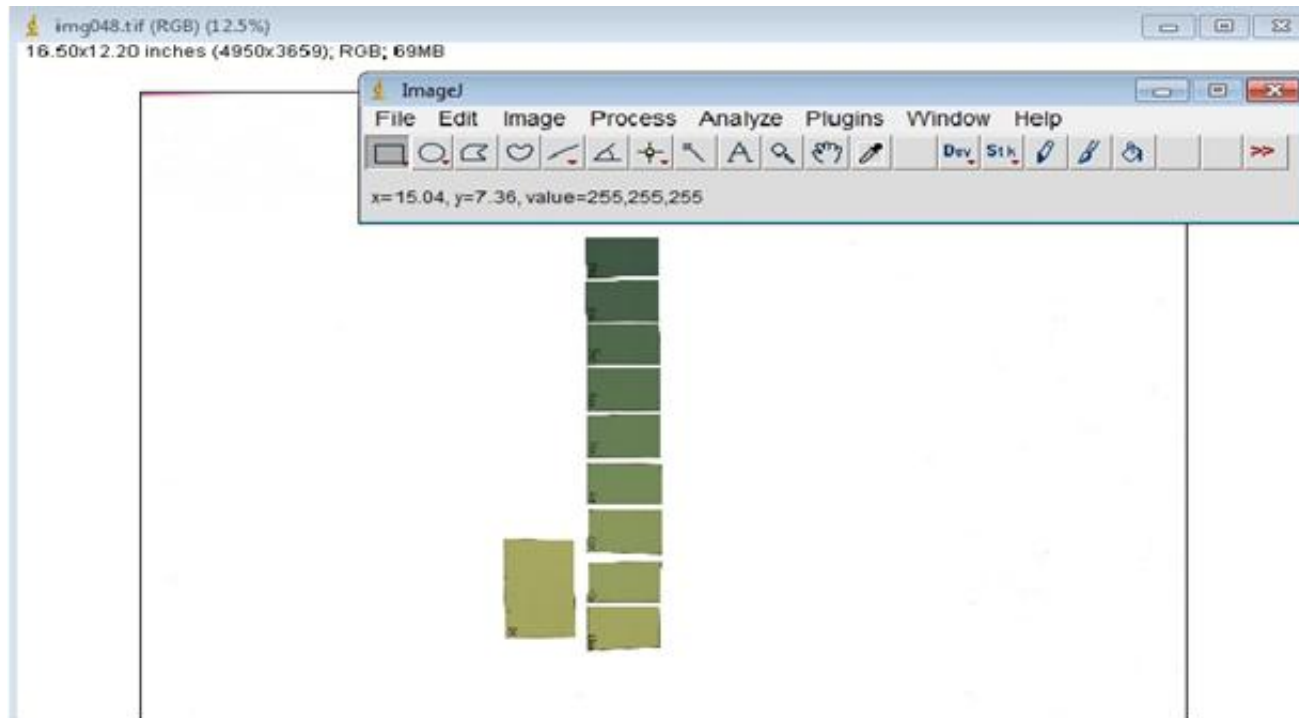
$$\text{O.D.} = \log(I_0/I)$$

Where, I_0 is the intensity of the incident light and I the transmitted light.

Introduction

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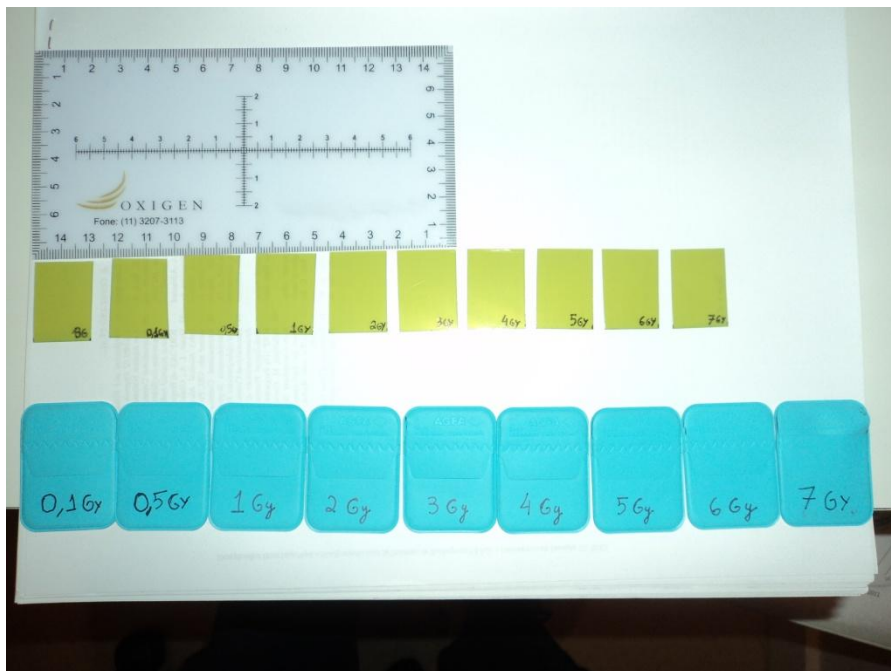
The ImageJ software consists on an image editor chosen in order to analyze the pre-scanned images of radiochromic films. With its *calibrate* tool, the software is capable of extract O.D values of the films.



Methodology

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The films were irradiated at the Radiotherapy Clinic (COI – *Clínicas Oncológicas Integradas* - in Portuguese) with the linear accelerator Trilogy Varian and the irradiated doses were chosen between the bands of 0,1; 0,5; 1; 2; 3; 4; 5; 6; 7; 8; 9; 10 Gy.



Methodology

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The irradiation geometry was chosen in order to ensure an electronic balance with the film positioned below 3 plates of solid water with 1 cm of thickness each and having 12 other plates of the same dimensions beneath



Methodology

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In possession of the irradiated films:

- *scanner* to obtain the digitalized images.
- extraction of the average O.D values, with the aid of ImageJ software.
- calculation of NET Optical Density (NET-O.D), subtracting each average O.D values from the background O.D (BG).
- raise of an Excel spread sheet in order to obtain the alpha and beta constants.

$$Net.O.D. = \alpha(1 - e^{(-\beta.x)})$$

Where, x refers to the deposited dose.

Methodology

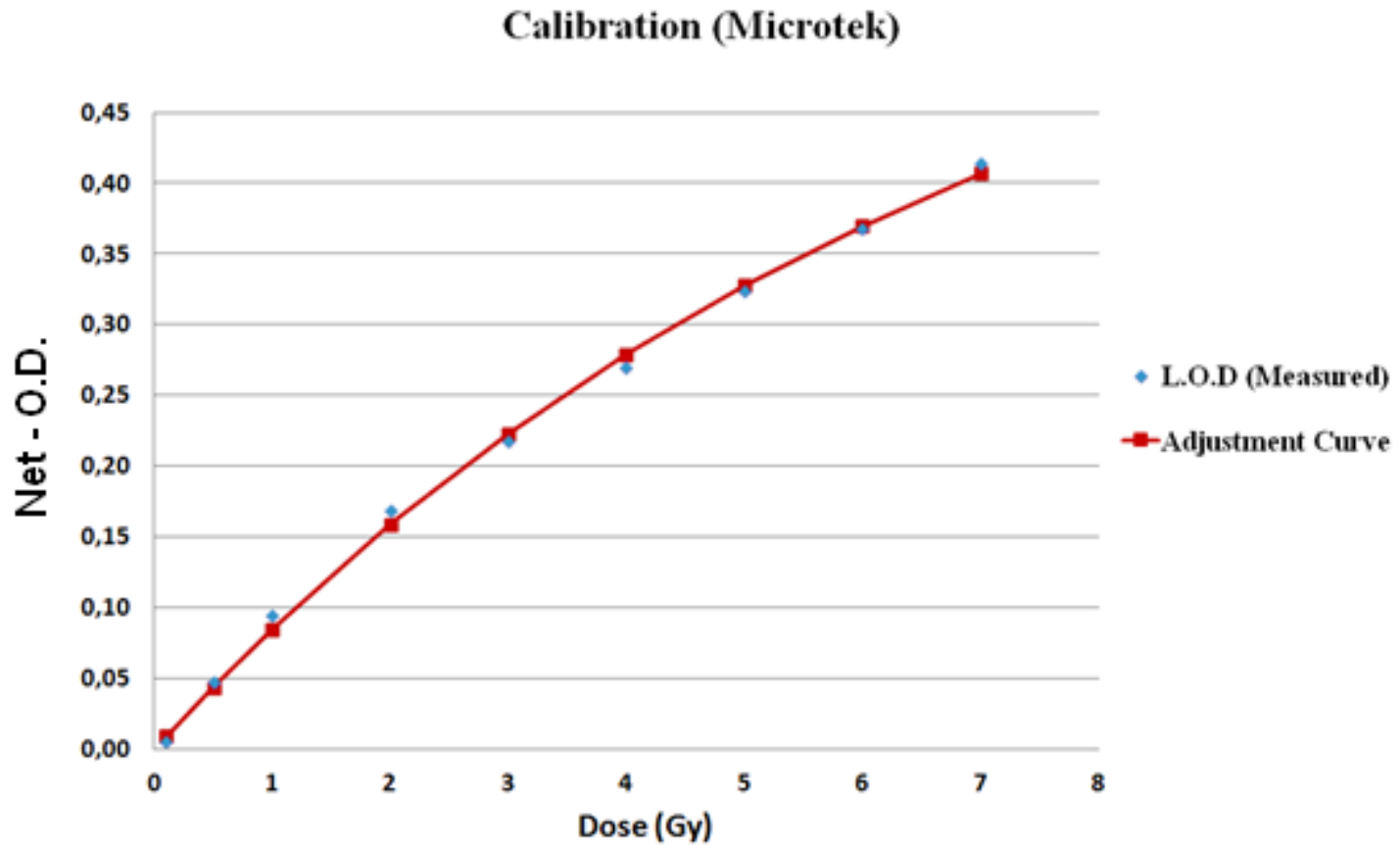
10

In the next step, a graphic of the NET-O.D value was plotted according to the given dose, as well as the adjustment of the NET-O.D curve, according to the given dose. This curve was used as a calibration curve, enabling to evaluate possible dose values of the films used in phantoms and isodoses of the braquitherapy source.



Results

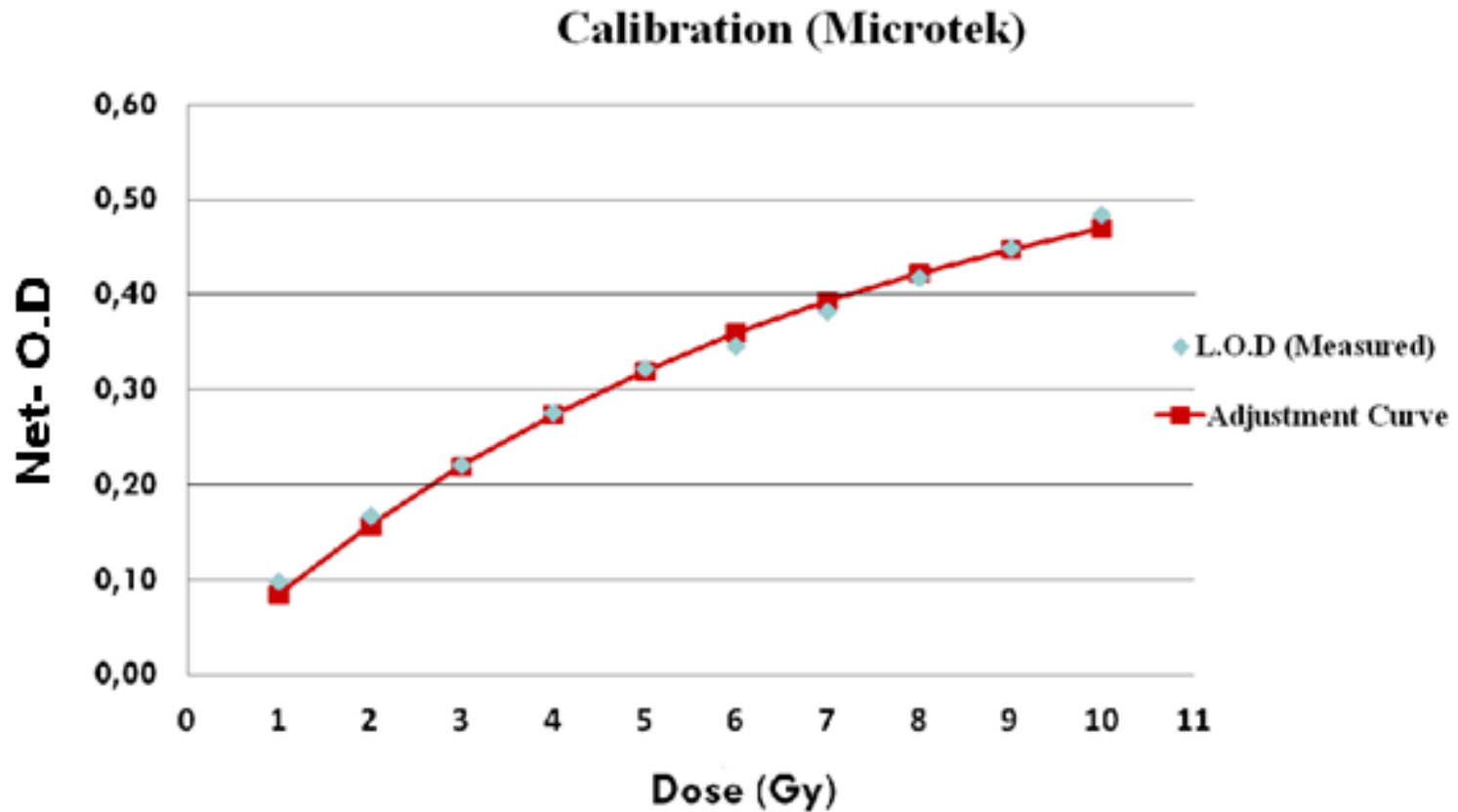
11



$$Net.O.D = 0,652(1 - e^{(-0,134.x)})$$

Results

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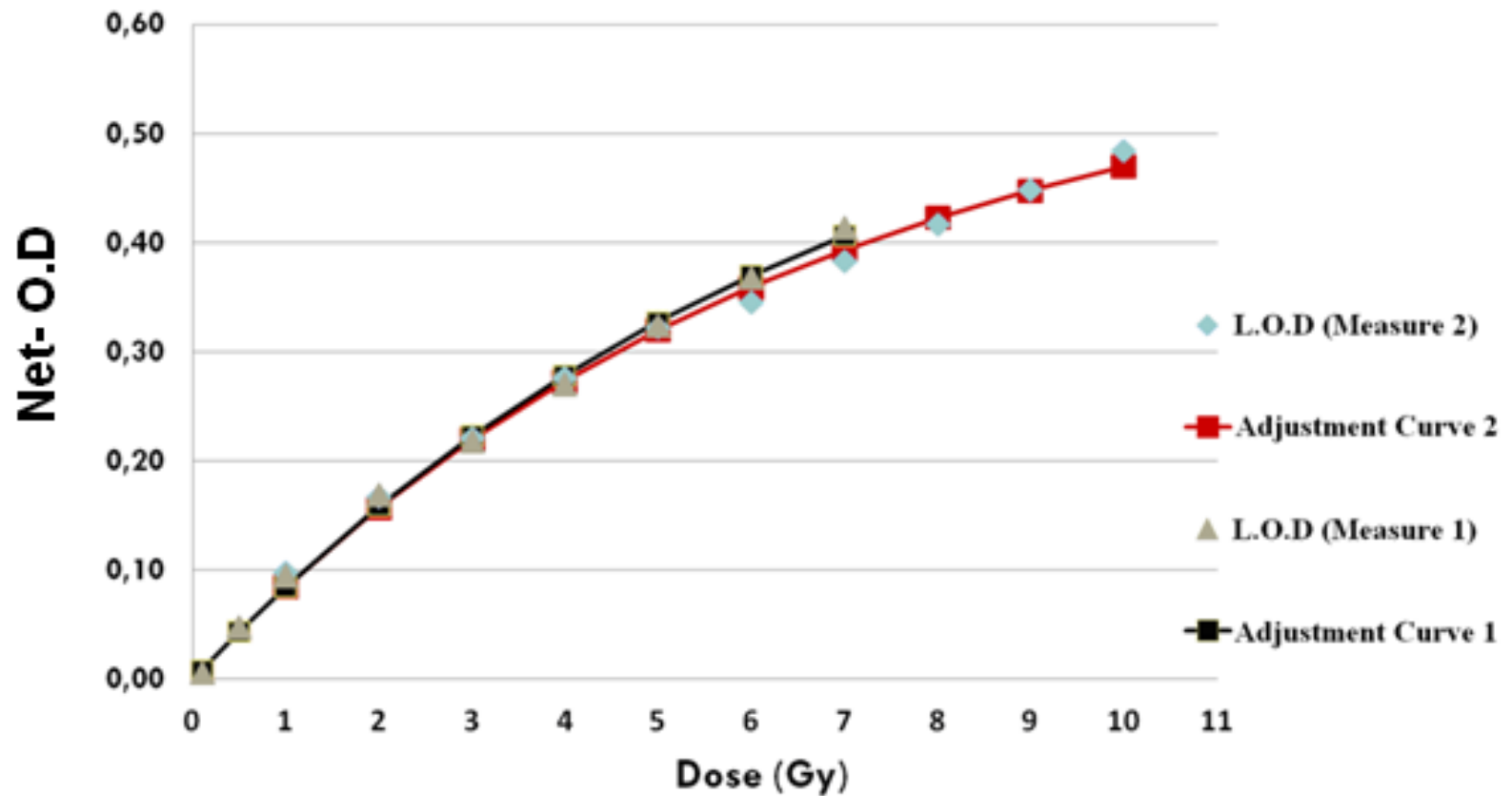


$$Net.O.D = 0,601(1 - e^{(-0,152x)})$$

Results

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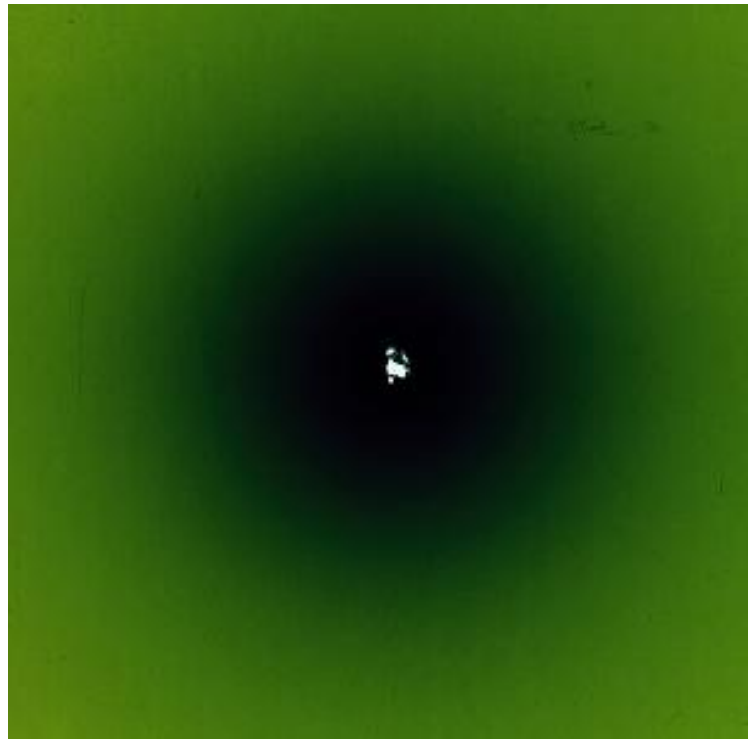
Measure 1 x Measure 2



Results

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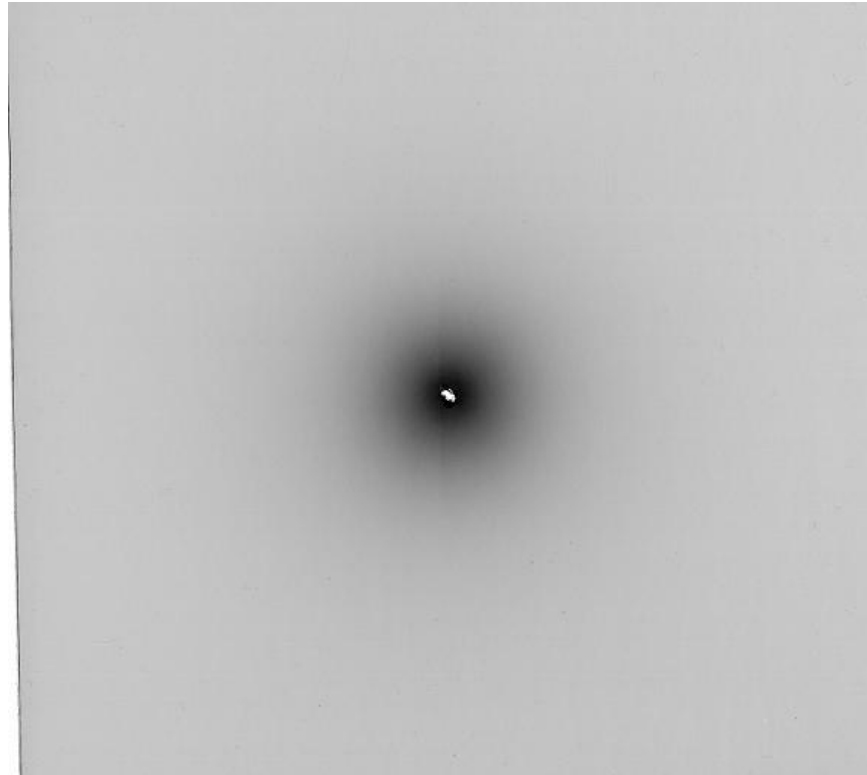
Radiochromic Film irradiated by the HDR brachytherapy source.



Results

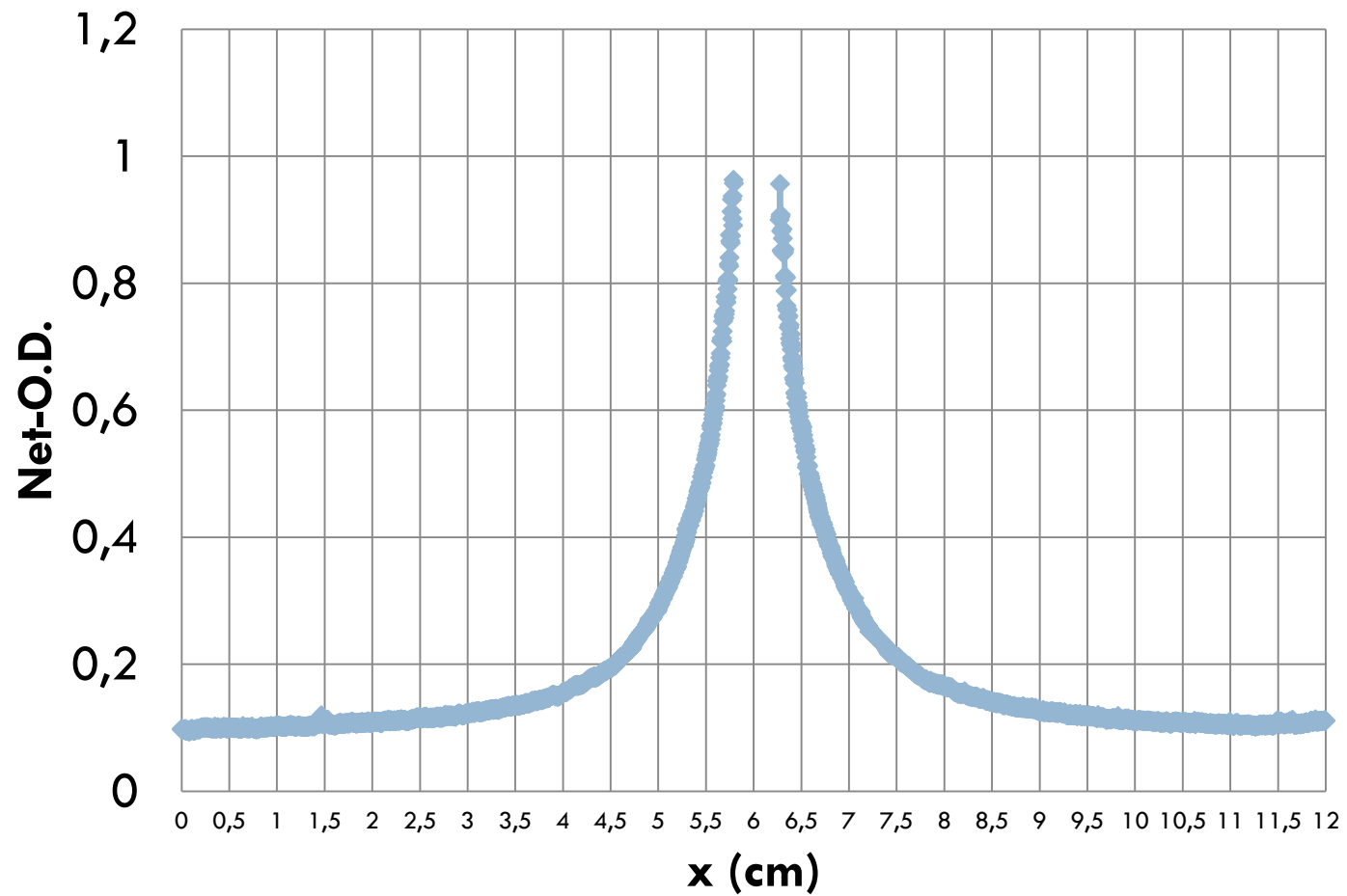
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Film's reading on ImageJ.



Results

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Conclusion

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- Successfully, the radiochromic film's calibration step was done.
- A calibration curve that is capable to associate any NET-O.D value to the dose to which it has been exposed is available.
- Finally, the Ir-192 brachytherapy source exposure will allow the survey of isodoses curves at the source transversal plan.

References

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<http://www.veritastk.co.jp/attached/2062/GAFCHROMICEBT2TechnicalBrief-Rev1.pdf> accessed on 13/06/2013.
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- Martin J. B et al. - Radiochromic film for medical radiation dosimetry - Materials Science and Engineering R 41 (2003) 61–120.
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Acknowledgement:

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