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36

Polychrome tetracycline bone labelling—New possibilities using spectral image analysis

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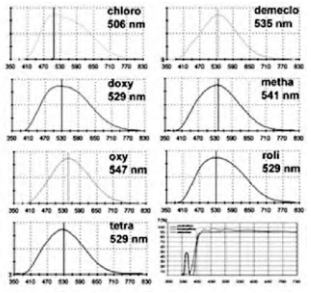
Introduction: Polychrome sequential labelling of bone is a standard technique to analyse bone growth or regeneration processes in vivo. Due to the fact, however, that most fluorochromes are not approved for a human application, this technique is mostly used in animal models. For human application, only the group of tetracycline derivates are approved. Because the wavelength is very similar between the single tetracycline derivates, the human eye can not discriminate between the different tetracyclines. To enable real polychrome fluorescent staining in humans, the aim of this study was to use differentiate tetracycline derivates by spectral image analysis and thereby allow real polychrome staining in humans.

Material and methods: For this purpose 24 five-week-old male Wistar rats (weight about 200 g) received 8 different tetracyclines (chlortetracycline, demeclocycline, doxycycline, methacycline, minocycline, oxycycline, rolitetracycline, and tetracycline) subcutaneously in a three day interval sequentially in different combinations. Bone specimen were embedded in methylmetacrylate, cut and investigated by a spectral camera (SpectralCube SD-300, ASI, Israel).

Results: Each tetracycline derivate revealed a characteristic fluorescence spectrum (Fig. 1). Three different groups out of the eight tetracyclines could be distinguished using spectral image analysis: Group 1 (506 nm): chlorotetracycline. Group 2 (529–535 nm): demeclocycline, doxycycline, rolitetracycline, tetracyclin. Group 3 (541–547 nm): oxytetracycline, methacycline. Linear unmixing and subsequent single depiction, however, was only possible with two different tetracyclines derivates in vivo.

Discussion: The technique of polychrome sequential labelling is feasible using two different tetracycline derivates and spectral image analysis. Having established this technique, the transfer of the dual labelling of bone for a human application is now possible for the first time.



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