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Cast biomechanics: A simple idea for reducing the cost and weight of plaster-cast orthoses: "Pyramidal shape"

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Objective: To reduce the cost and weight of plaster molded orthosis (increasing patient comfort), keeping the same resistance.

Methods: 22 plaster orthosis were laboratory analyzed 11 with conventional shape and 11 with pyramidal shape. It was compared, in theory (mathematically) and practice, the change of weight (and consequently cost) and flexion resistance between conventional shape and pyramidal shape.

Results: Theoretical analysis: weight and cost decrease of 26.7%-38.9%, according to the layers disposition of the cast. Laboratorial analysis: cast´s weight decrease of 34.5% (p=0.000005) and resistance increase of 26.7% (p=0.03).

Conclusion: Plaster molded orthosis made in a pyramidal shape, have a statistically significant decrease of weight (and consequently cost) and statistically significant increase of resistance if compared with traditional shape.

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Optimal control model for pair chemotherapy treatment with time-delay immunity in dual HIV infectivity

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The incurable status of HIV/AIDS and its associated virus infectivity had continuously led to series of scientific research, geared towards the amelioration of the increasing trend of the deadly disease. In this paper, ordinary differential equations were used for the formulation of a 4-dimensional mathematical dynamic HIV-pathogen model. The model was presented as an optimal control problem, which accounted for the methodological pair chemotherapy treatment, with treatment factors clinically sandwiched in two temporal time-delay immunity chambers. The methodology of the model involved dual infectious variables, pair treatment factors (RTI and PI), with immune system cells as vectors. The study explored numerical methods with analysis conducted using Pontryagin's Maximum Principle. The non-negativity solution of the model was proved and as well, established the existence and uniqueness of the optimal control strategy, which led to the derivation of the model optimal dynamic solution. Numerical computations of the model, using Runge-Kutta of order four, in a Mathcad environment were demonstrated. Precised novel results not only agreeing with known existing models but also showed that the higher the amount of optimal weight factor, which enhances the toxicity of the drug; the earlier, efficient, faster and less amount of chemotherapies required for the maximization of healthy CD4+ T cell concentration. Furthermore, sustainability of declined infectivity and significant minimization of optimal cost was a function of prolong treatment schedule with drug validity period accounted for. The study which could be readily adopted for other infectious diseases suggests further investigations with more interplay of multiple control functions.

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