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PREFÁCIO

Este livro contém os resumos dos trabalhos apresentados no 7º Congresso Nacional de Biomecânica (CNB2017) que decorreu no Departamento de Engenharia Mecânica da Universidade do Minho, em Guimarães, Portugal, nos dias 10 e 11 de fevereiro de 2017.

O Congresso Nacional de Biomecânica (CNB) é o mais importante e prestigiado encontro científico organizado em Portugal, na área da Biomecânica. O CNB é um importante fórum de discussão e colaboração entre investigadores das várias áreas da Biomecânica, promovendo parcerias e projetos de investigação de interesse comum. Além disso, o CNB procura incentivar a participação dos estudantes com o objetivo de potenciar o crescimento e a interação da Biomecânica em Portugal.

O evento é bienal, e a primeira edição, sob o nome "Encontro 1 Biomecânica", realizou-se em Martinchel, Abrantes em fevereiro de 2005. Em 2007 realizou-se o 2º Encontro em Évora. Na terceira edição, realizada em Bragança em 2009, houve uma alteração de designação para o atual Congresso Nacional de Biomecânica. Nas edições seguintes, 2011, 2013 e 2015, o Congresso Nacional de Biomecânica continuou a crescer tendo-se realizado em Coimbra, Espinho e Leiria, respetivamente.

Nesta 7ª edição do Congresso Nacional de Biomecânica foram aceites cerca de 160 trabalhos de 10 países. O presente livro está dividido em diversos capítulos que refletem os diferentes tópicos do congresso, nomeadamente: antropometria; biofabricação; biomateriais; biomecânica cardiovascular, biofluidos e hemodinâmica; biomecânica celular e molecular; biomecânica da lesão/impacto; biomecânica de reabilitação; biomecânica desportiva; biomecânica do crânio e coluna; biomecânica do sistema músculoesquelético; biomecânica dos tecidos; biomecânica ocupacional; biomecânica orofacial; biomecânica ortopédica; biomecânica respiratória; cirurgia assistida por computador; engenharia dos tecidos; ensino da biomecânica; mecânica experimental em biomecânica; visão por computador em biomecânica.

A Comissão Organizadora do CNB2017 agradece a todos os Patrocinadores pelo apoio concedido, bem como à Comissão Científica pela cooperação e avaliação dos trabalhos. Uma palavra especial para os autores, porque sem autores não haveria CNB. Por último, um agradecimento especial à Sociedade Portuguesa de Biomecânica pelo privilégio que nos concedeu de poder organizar o 7º Congresso Nacional de Biomecânica, e pelo muito apoio que prestou.

Guimarães, 10 de fevereiro de 2017

A Comissão Organizadora

Paulo Flores
Filipe Marques
Filipe Silva
José Carlos Teixeira
José Luís Alves
José Pimenta Claro
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INTRODUCTION OF THE PRESIDENT OF SPB

Dear Colleagues,

This year we are attending to the 7th Congress of the Portuguese Society of Biomechanics (SPB). The Congress is probably the most important event of the Society, and its regular organization, every two years since 2005, is an evidence of the vitality of the scientific community on Biomechanics. In the present Congress we have 159 presentations (138 oral and 21 posters) and, once again, we reward excellence on the biomechanics research through the Young Researcher Award (Prize "João Arménio Correia Martins"), Best Poster Award, Best MSc Student Award and Best PhD Student Award. Thus, the congress is a strong contribution for encouraging, supporting and disseminating the biomechanics research undertaken in Portugal.

The research and development on biomechanics has a great impact on public health and people's wellness. The state of the art achieved in some areas of biomechanics requires increasing efforts on translation for a better understanding of the importance of public investment on research. It is this challenge I launch to you for the coming years, wishing we are able to work together on this objective. The Portuguese Society of Biomechanics will play its role being a keystone for the researchers to develop their work. The Congress is an opportunity of excellency to find new partnership and to define collaborative projects.

I finish by sincerely thanking the organizing committee, in particular Prof. Paulo Flores, for their professional work during the organization of CNB2017 and wishing to all delegates a very successful event.

Guimarães, February 10th, 2017

Paulo R. Fernandes

President of SPB

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EFFECT OF DRILL SPEED DURING DRILLING OF HUMAN CADAVERIC TIBIAE

M.G. Fernandes[1], E.M.M Fonseca[2], R. Natal[3], M.C. Manzanares[4] and L. Azevedo[5]

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KEYWORDS: Drilling, Cadaveric Tibiae, Thermal Necrosis, Thermocouple

ABSTRACT: *Bone fracture is a feature of everyday life. Most of the treatments involve bone drilling to fixation of implanted medical devices. Bone loss due to excessive produced heat during drilling may weaken the purchase of surgically placed screws and pins, causing them to loosen postoperatively. Decrease the heat generation has a great demand as it helps in better fixation and healing of bone tissue. This paper presents an experimental model to study the effect of drill speed using human cadaveric tibiae. The results revealed that the temperature rise and the duration of temperature elevation decreased when lower drill speeds are used.*

1 INTRODUCTION

Bone drilling is a significant part of many medical interventions, including orthopaedic surgeries. Every day, millions of accidents happen involving bone fractures. The treatment normally requires drilling for screw placement, temporary bone fixation and surface preparation for joint fusion. Significant heat is produced during drilling due to the friction between the cutting surface of the drill bit in contact with the hole and bone fragments. When the temperatures obtained during drilling operation reached the limit supported by bone tissue, thermal necrosis occurs [1]. This damage to bone cells would delay the healing process after the surgery and reduce the strength of the fixation. In order to minimize the damage caused by the high temperature and to improve this procedures, it is necessary to optimize the drilling parameters. Many researches have been conducted to find out effects of different drilling parameters such as feed-rate, drill speed, drilling depth, drilling force and drill bit diameter. However, most of these studies use animal bones or synthetic bones to replace the human bone. Although the properties may be similar, drilling of human bone tissue might show a different response compared to animal models [2].

The aim of the present investigation was to measure the temperature rise from three different drill speeds using human cadaveric tibiae and relate the results to the operating drill speed.

2 MATERIALS AND METHODS

Experimental tests were conducted on four bone specimens, measuring 22 to 25 cm in length as show in Fig. 1. The non-embalmed sections of human cadaveric tibiae were processed in the Body Donor's Service and Dissection Room of the University of Barcelona.

The mean rise temperature, drilling time and the time needed for the bone samples to return the initial conditions were monitored using a datalogging thermometer (Extech

SDL200: 4-Channel Datalogging Thermometer). Two K-type thermocouples with 2 mm of diameter were placed into a hole, as closely as possible to the drilled area (approximately 2-3 mm). The drill bit temperature was also monitored and controlled by a thermographic camera (ThermaCAM 365, FLIR Systems) which was fixed to a tripod at a distance of 1.5 m from the drill bit.

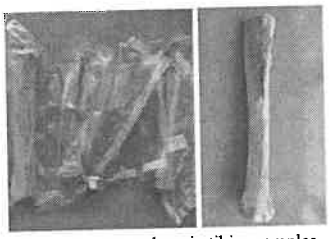

Fig. 1 Human cadaveric tibiae samples

Several holes were made at three different drill speeds (520, 900 and 1370 rpm), in order to evaluate the influence on the drilling process. These velocities were chosen according to the speeds normally used in orthopedic surgeries. The feed-rate was not controlled, since in orthopaedic practice this parameter varies from surgeon to surgeon and in this particular case there will also be a variation, since the drill is hand-held. All the other parameters were considered constant. The holes were made through a drill press machine with multiple speed control and using a twist drill bit with 4 mm of diameter and point angle equal to 118° (Fig. 2). The measurements started from room temperature (23 °C) and each combination of machining parameters were randomly repeated four times. All experiments were performed without irrigation at the drilling site.

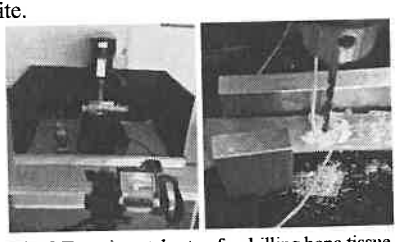

Fig. 2 Experimental setup for drilling bone tissue

3 RESULTS AND CONCLUSIONS

The difficulty in measurements during bone drilling is a common knowledge due to complex nature of the bone tissue as well as the process itself. It is well known that there is variation of the properties from samples taken from different bones species, outcome in variations of results, although subject to identical drilling conditions. In this way it is important, whenever possible, use human bones to ensure reliable results. This study experimentally investigates the effects of drill speed on the elevation of bone temperature during drilling in human cadaveric tibiae models. Within the limits of the present study, results showed that the bone drilling at 520 rpm generates less heat than at faster speeds. These results are in accordance with those of recent studies, using animal models [3].

ACKNOWLEDGMENTS

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