



Vera Chéroux<sup>1</sup>, Pedro Cebola<sup>1</sup>, Luis Xavier Santos<sup>1</sup>, Alexandra Bernardo<sup>1,2</sup>, André Almeida<sup>1,2</sup>, Carlos Família<sup>1,2</sup>, Catarina Godin Sérgio Félix<sup>1,2</sup>

<sup>1</sup>Instituto Superior de Ciências da Saúde Egas Moniz (ISCSEM), Quinta da Granja, Monte de Caparica, 2829-511 Caparica, Portugal. <sup>2</sup>Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Cooperativa de Ensino Superior, C.R.L., Quinta da Granja, Monte de Caparica, 2829-511 Caparica, Portugal.

**INTRODUCTION:** It is widely accepted that the putt in golf depends primarily on the expertise, concentration, and postural control of the performer, in which, stabilization of the mandibular position is of great importance. Previous studies have shown that this stabilization can be optimized with the use of removable intraoral devices that allow precise contact of the teeth from the two arches (1). Herein we report influence of the use of intraoral devices (IOD) in the putt performance of golf athletes.

**MATERIALS AND METHODS:** After study approval by the Ethic Commission of the Cooperativa de Ensino Superior Egas Moniz, athletes from the Centro Nacional de Formação de Golfe do Jamor (CNFGJ) were invited to participate in this study. Following the informed consent a Diagnostic Criteria for Temporomandibular Disorder (DC/TMD) was applied. Individualized IOD were developed for each athlete. Athletes were evaluated at two different stages: a) Accurate phase (AP) - on the first day of application of the IOD; and b) Chronic phase (CP) - after one week of frequent use of the IOD. In both cases, 20 putts were analyzed with and without IOD. Sam PuttLab (Science & Motion GmbH) was used for task analysis and performance recording. Linear mixed effects models were used to analyze the effects of the utilization of the IOD and adaptation stage in the balls' distance to the hole (BDH) (fig. 4), in the percentage of putt success (PPS) (fig. 5), and several measures of technique (club angle on impact, local of impact and club trajectory). The significance of these effects was assessed through the analysis of variance of type III with Kenward-Roger approximation for degrees of freedom.



FIGURE 1 - Centro Nacional de Formação de Golfe do Jamor - Lisboa (CNFGJ).



FIGURE 2 - IOD after obtaining Centric Relation and occlusal adjustments



FIGURE 3 - Athlete preparing to putt with SAM PuttLab analysis

**RESULTS:** In this study 17 volunteer golf athletes were included, 88% (15) were male and the average age was 26.2 (± 6.74) years. The developed linear mixed effects models for BDH and PPS shown to be significantly different from the null model ( $\chi^2(3) = 9.6314, p \leq .022$  and  $\chi^2(3) = 8.194, p \leq .042$ , respectively). Analysis of variance shown the interaction between the use of the IOD and the adaptation stage to affect significantly the BDH ( $F(1,34) = 2.128, p \leq .034$ ), reducing in average 6.78 cm the BDH from the IP without IOD to the AP with IOD (Tab 1, Graph 2 and 3). Moreover, it also shown that the use of IOD affects significantly the PPS ( $F(1,34) = 7.8140, p \leq .008454$ ), increasing in average 1.6% the PPS (Tab 2, Graph 4 and 5).



FIGURE 4 - BALL'S DISTANCE TO HOLE

	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION
ACCURATE PHASE WITHOUT IOD	10	60,3	28	31,023	14,318
ACCURATE PHASE WITH IOD	14,95	59,27	26,8	32,664	13,316
CHRONIC PHASE WITHOUT IOD	5,63	58,66	30,9	30,893	14,995
CHRONIC PHASE WITH IOD	7,28	37,5	24	22,931	11,754

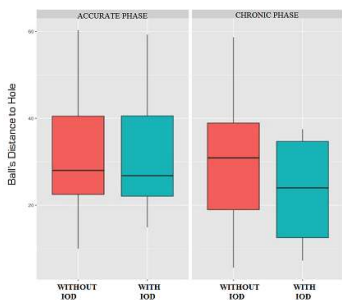
TABLE 1: Minimum, maximum, median, mean and standard deviation values of Ball's Distance to hole (BDH) (mm) in AF (Accurate phase) and CF (Chronic phase), with and without the use of the IOD (WIOD and WtIOD)



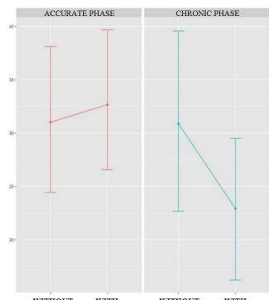
FIGURE 5 - PERCENTAGE OF PUTT SUCCESS

	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION
ACCURATE PHASE WITHOUT IOD	0	50	20	25,333	16,417
ACCURATE PHASE WITH IOD	0	60	30	31,333	16,846
CHRONIC PHASE WITHOUT IOD	0	50	30	22,727	16,787
CHRONIC PHASE WITH IOD	0	60	40	36,363	21,105

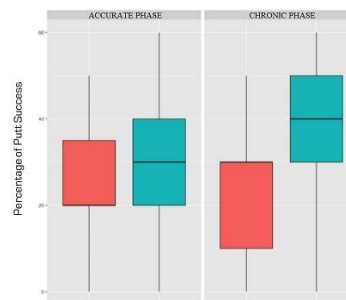
TABLE 2: Minimum, maximum, median, mean and standard deviation values of Percentage of putt success (PPS) in AF (Accurate phase) and CF (Chronic phase), with and without the use of the IOD (WIOD and WtIOD)



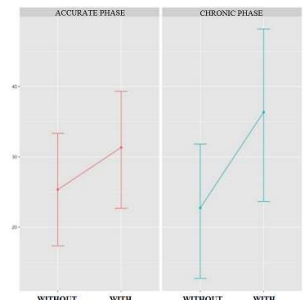
GRAPH 1: Box plot Graph of quartiles related to Ball's Distance to Hole with and without the use of the IOD in the two moments of evaluation



GRAPH 2: Main effects of the use of IOD and moments of evaluation relative Ball's Distance to Hole



GRAPH 3: Box plot Graph of quartiles related to Percentage of Putt Success with and without the use of the IOD in the two moments of evaluation



GRAPH 4: Main effects of the use of IOD and moments of evaluation relative Percentage of Putt Success

**DISCUSSION AND CONCLUSION:** Our results show that, after the habituation period of the use of an IOD with the purpose of increasing the stabilization of the mandibular position, the accuracy was significantly improved (with a decrease of 6.78 cm in the balls' distance to the hole) but not the technique of the putt. Our results are in agreement with Pae and coworkers' findings where the use of IOD promotes an improvement in both isokinetic muscle strength and mental capacity for concentration at the time of impact of the golf club with the ball, which leads to greater precision of movement (2).

**References:**

(1) Okeson, J. P. (2013). *Management of Temporomandibular Disorders And Occlusion* (Vol. 7th).  
 (2) Pae, A., Yoo, R., Noh, K., Paek, J., & Kwon, K.-R. (2013). The effects of mouthguards on the athletic ability of professional golfers. *Dental Traumatology*, (29), 47-51. <http://doi.org/10.1111/j.1600-9657.2012.01123.x>