Impaction forces and proper seating of ceramic ball heads

+Pandorf, T; Preuss, R; Czak, R
CeramTec AG, Plochingen Germany
Senior author: t.pandorf@ceramtec.de

INTRODUCTION

The advantage of a modular implant system is that the surgeon is able to choose the stem and a ball head of appropriate sizes from a series of components and assemble them by using a standardized connection. Herewith, the implant can be adapted to the individual patient. In the preoperative planning the appropriate combination is chosen but also during the surgery it is possible to select the ideal combination. Beside the benefit of a modular connection, disadvantages are provided by this connection technique as well. The ceramic ball head is recommended as being manually assembled during surgery on a dry and clean taper with a quarter of a rotation to ensure that the ball head is centered on the stem. To assure a secure connection between the ball head and the stem a slight axial tap using a plastic impactor should be applied to the ball head. According to investigations related to current surgical practice, it has been found that during the intraoperative assembly of the ball head and the taper, the forces applied by the surgeon show a large variation. In some cases, surgeons are even avoiding the impaction.

This study shows the importance of an impaction force for the connection strength and particularizes and quantifies the necessary assembling force.

METHODS:

Ceramic ball heads made of pure alumina have been assembled in an in-vivo like test setup using static and dynamic forces. Three different dynamic force values of 1 kN, 2.2 kN, and 4 kN have been applied using a drop weight. The values have been derived from the previously mentioned investigations of current surgical practice. Additionally, an experimental group was tested using multiple impacts. As a control group, ceramic ball heads were mounted on the metal stems using just manual pressure with a light twist. Here, several axial forces were used: slight axial force (74 N), normal axial force with pressure coming from the forearm (94 N), and strong axial force (124 N) using the body weight to produce the axial force. The measured force values as well as the force necessary to pull-off the ball heads were used to evaluate and assess the results.

RESULTS:

The dynamically mounted parts show a linear correlation between the applied impaction force and the pull-off force, see figure 2. In comparison to the statically mounted parts, the pull-off force of the impaction with 1 kN is about 33% higher.

DISCUSSION:

The investigation clearly shows that an impaction after inserting the ceramic ball head with a light twist while applying manual pressure is necessary to obtain a secure connection between the metal taper and the ceramic ball head. A second impact has no adverse influence, it might reduce the risk of an insufficient impact by a non-axial first impact. The intraoperative fixation of a ceramic ball head on the metal stem should be performed on a dry and clean metal taper. In order to avoid a loosening of the connection assembly under eccentric or dynamic in-vivo loads, the ball head should be impacted with one or more light taps on the plastic impactor.

REFERENCES: