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Forces that fracture teeth during extraction with mandibular premolar and maxillary incisor forceps

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Abstract

Our aim was to measure the forces that fracture teeth during extraction based on the effectiveness of the extraction forceps, and to compare them with data collected about forces applied to extracted teeth that did not fracture. We studied 208 patients whose teeth fractured during both the standard and our new method of extraction: maxillary incisors (n=79) extracted with forceps 1 (maxillary incisor forceps), and both maxillary (n=95) and mandibular incisors (n=34) extracted with forceps 13 (mandibular premolar forceps). Forces needed to fracture were assessed with a specially-designed instrument for measuring pressure and rotation. Mean (SD) pressure at the fracture site was significantly higher in maxillary incisors extracted with forceps 1 (1.26 (0.26) bar) then in both maxillary and mandibular incisors extracted with forceps 13 (0.96 (0.19) and 0.98 (0.16), p<0.001). Pressure at dislocation and both left and right rotation showed similar patterns. Pressure correlated to root surfaces of teeth ranging from r=0.35-0.54 but the correlation coefficients did not differ significantly between the teeth-forceps groups. Pressure was higher in fractured than in extracted teeth, and this varied from 3%-48%. In conclusion, forces that break teeth during extractions are sometimes only slightly higher than the extraction forces, so caution is needed during extraction.

Keywords: Tooth fracture forces; Tooth extraction forceps; Tooth extraction

Introduction

The greatest area of stagnation in modern dentistry has been in that part of oral surgery that deals with extracting teeth, evidence of this being that today's tooth extraction forceps have the same shape and design that they had in 1827 when Cyrus Fay designed the forceps that are identical to those currently used in nearly every dental clinic.[1] There are two possible explanations: either the design of today's forceps is faultless and needs no change after almost 200 years, or there is no objective evidence or quantifiable research into the forces of tooth extraction, luxation, and rotational movements, or the behaviour of the teeth and forceps during extraction. The paucity of studies dealing with the forces of tooth extraction and movements of teeth gives credence to the second explanation.[2–5] The only research that we know of that comes closest to describing, measuring, and studying forces used to extract teeth is one that was conducted on patients, rather than in vitro studies on poorly-suited models or computer simulations.[6]

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An important issue was to find an instrument that was able to measure the forces exerted during extractions. Only after measuring, analysing, and processing data can a better understanding of extraction forces and movements of teeth be achieved. New techniques and instruments can facilitate tooth extraction on the one hand, and reduce injury to patients on the other. Once measurements have been made, extraction forces for various groups of teeth can be assessed (for example, premolars and incisors), and tables of recommended values and maximum forces after which teeth may break can be constructed.

The purpose of this study was to measure tooth-breaking forces during extraction from the point of view of the efficacy of the extraction forceps, and to compare them with our previously published data on extraction forces on teeth which have not fractured during the same procedure.[6]

Patients and methods

We studied 208 patients who were operated on by VA during the two-year period 2003-4 when the standard method for extracting maxillary and mandibular incisors was compared with a new method. All patients had been referred to the Department of Oral and Maxillofacial Surgery of the University Hospital, Rijeka, for extraction of teeth. The patients were randomly assigned to two groups. The experimental group comprised 145 patients who had extractions of maxillary and mandibular incisors with lower premolar forceps (No. 13), and a control group that consisted of 63 patients whose extractions were done in the usual way – maxillary incisors with maxillary incisor forceps (No. 1).

All subjects were informed of our aims and procedures, and that their data would be used for research purposes. The Ethics Committee of the Medical Faculty of the University of Rijeka approved the protocol. Only those who gave written informed consent were included.

Each patient completed a questionnaire giving personal and clinical information. The research involved only teeth with normal mobility. The bony density, the quality of the supporting bone, and the number of periodontal fibres attached to a tooth could not be established precisely without sophisticated methods, so the condition of supporting tissue was established by its degree of mobility.

Measurement of pressure forces

Fracture forces were assessed with a specially-designed instrument that measures pressure and rotation (Fig. 1). It was patented in 2003 (patent request no. HR P20030692A, in the register of patents of the Office for Intellectual Property). According to the International Classification it was classified as G 01 D 21/00, and is manufactured by M. Saracevic and V. Ahel. To use the instrument, air bags made of silicone rubber with three pockets were pulled on to the handles of the forceps through the cylindrical holes provided (Fig. 1). Then

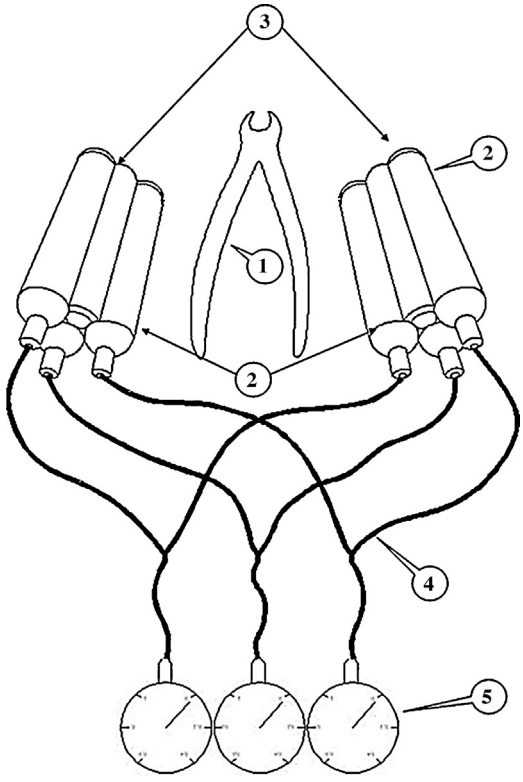

Fig. 1. Instrument for measurement of pressure and rotation.

pressure and rotation forces can be measured by connecting the six pockets on the two handles to three manometers using tooth extraction forceps (Fig. 1). The automatic manometer blocking system enabled the measurement of the maximum pressure force applied on manometer 2. The forces applied in rotation to the left and right were recorded on manometers 1 and 3, respectively. The values obtained on the manometers are expressed in bars, and they express the force of pressure on the handles of the forceps. The pressure forces were measured by the three manometers, which were calibrated up to 1 bar. Manometers 1 and 3 measured left and right rotation, respectively, while manometer 2 measured dislocation of the tooth.

Measurement of the surface of the tooth

The extracted teeth had one root each to simplify measurement. The surface of the tooth's root was directly connected to the extraction force by the resistance that developed during extraction. The root of the extracted tooth was measured in five different places with sliding callipers, and the surface of the tooth was established by measuring these dimensions and calculated by the formula for an irregular cone surface.