This readme file functions as an introduction and legend for the ‘A Multiclass classification model for tooth removal procedures’ dataset.   
  
**Introduction:**This dataset can be used to reproduce results from the ‘A Multiclass classification model for tooth removal procedures’ paper as written by ‘de Graaf’ et al. in 2022. Data was captured in experiments on seven Fresh Frozen cadavers. Data has been pre-processed, as stated in the article. For example, the data has been transformed into the clinical relevant tooth frame (see Table 1).

*Table 1: Tooth reference frame after mathematical transformation from the center of the force/torque sensor to the center of the tooth*

|  |  |  |
| --- | --- | --- |
| Axis | Positive | Negative |
| X-axis force | Buccal | Palatal / Lingual |
| Y-axis force | Mesial | Distal |
| Z-axis force | Extrusion | Intrusion |
| X-axis rotation | Mesial angulation | Distal angulation |
| Y-axis rotation | Buccoversion | Palatoversion / Linguoversion |
| Z-axis rotation | Mesiopalatal / Mesiolingual | Mesiobuccal |

**Columns, general:  
A Case number**: corresponding to the cadaver number to which the jaws belong. Numbered 1 to 7.   
**B Tooth number:** The ISO (International Standards Organization number 3950, Fédération Dentaire International) system was used as dental notation system. If a first experiment did not succeed, but removal was still possible, the tooth number was extended with a 1 (second try) or 2 (third try), when applicable. In example, the 16 in case number 3 was insufficiently fixated which was noted directly at the start of treatment. A new experiment number was started as 161 (as a second try) but it was still not fixated correctly so a third attempt was necessary (162).   
**C Jaw type:** divided between upper and lower jaw  
**D Amount of roots**: as counted after the experiment. In case of complications with retained roots, a ‘-‘ is marked for missing data.  
**E Complications:** categories are ‘none’, ‘crown fracture’, ‘root fracture’, ‘boney wall fracture’ and combinations. This column was used in the paper only as a descriptive parameter. Because of the small data sample, no statistical analysis were performed.   
**F Restorative state:**  divided in ‘Sound’, ‘small direct restorations’, ‘large direct restorations’ and ‘indirect restorations’. Direct restorations could be either amalgam or composite.   
**G Periodontal state:** dividedin ‘Sound’, ‘Recession’, ‘Mild decay’, ‘Severe decay’ or combinations  
**H Surgeon:** there were 3 surgeons involved, all being expert and senior oral and maxillofacial surgeons with vast experience.   
**I Time:** duration of experiment expressed in seconds  
  
**All 33 selected features for the model have been incorporated into this dataset (see Table 2).**

*Table 1. An overview of the remaining features after the feature selection process. AUC = area under the curve, n = number, N = Newton, Ns = Newton second, Nms = Newton meter second, deg = degree, deg/s = degrees per second, (+) = only positive values on specified axis, (-) = only negative values on specified axis, X-axis = buccolingual, Y-axis = mesiodistal, Z-axis = longitudinal axis. X+Y+Z = sum of all axes. In case of rotational data (torques and all rotational data features) a rotation around the mentioned axis takes place. The corresponding column in the dataset is in the ‘Direction’ column directly after the direction of each axis.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Force and torque data features** | **Axis** | **Direction** | **n = 17** |
| sum (AUC) of Forces (Ns) | X+Y+Z X-axis (+) Y-axis (-) Z-axis (-) | all (J) buccal (K) distal (L) extrusion (M) | 4 |
| Average Forces (N) | X+Y+Z Y-axis (+) | all (N) mesial (O) | 2 |
| sum (AUC) of Torque (Nms) | X+Y+Z Y-axis (+)  Z-axis (+) Z-axis (-) | all (P) buccoversion (Q) mesiobuccal rotation (R) mesiopalatal-lingual rotation (S) | 4 |
| Average torques (Nm) | X+Y+Z X-axis (+)  Y-axis (+) Z-axis (+) | all (T) mesial angulation (U)  buccoversion (V) mesiopalatal-lingual rotation (W) | 4 |
| Peak forces (N) | X+Y+Z | all (X) | 1 |
| Peak torque (Nm) | X+Y+Z | all (Y) | 1 |
| Percentage of amount of force, relative to the sum of all three axis (%) | Z-axis | intrusion/extrusion (Z) | 1 |
| **Rotational data features** | **Axis** | **Direction** | **n =16** |
| Percentage of amount of rotation, relative to the sum of all three axes (%) | Y-axis Z-axis | mesial-distal angulation (AB) mesiobuccal/ mesiopalatal-lingual rotation (AC) | 2 |
| Maximum rotations (deg) | Y-axis (+) Z-axis (-) | buccoversion (AD) mesiopalatal-lingual rotation (AE) | 2 |
| Average rotations (deg) | Y-axis (+) Y-axis (-) Z-axis (+) Z-axis (-) | buccoversion (AF) linguoversion (AG) mesiobuccal rotation (AH) mesiopalatal-lingual rotation (AI) | 4 |
| Variation of rotation on a single axis (deg) | Z-axis | mesiobuccal/ mesiopalatal-lingual rotation (AJ) | 1 |
| Maximum rotational velocity (deg/s) | Y-axis (+) Y-axis (-) Z-axis (+) Z-axis (-) | buccoversion (AK) linguoversion (AL) mesiobuccal rotation (AM) mesiopalatal/lingual rotation (AN) | 4 |
| Variation of rotational velocity on a single axis (deg/s) | X-axis  Y-axis Z-axis | bucco-palato/linguoversion (AO) mesial-distal angulation (AP) mesiobuccal- mesiopalatal/lingual rotation (AQ) | 3 |