



Classification proposal for fractures of the processus condylaris mandibulae

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Abstract

Objective The current classification of mandibular condyle fractures as basal, low neck, and high neck as reported by Loukota et al. (Br J Oral Maxillofac Surg 43:72–73, 2005) and Neff et al. (Craniomaxillofac Trauma Reconstr 7:S44–S58, 2014) has a weakness. Nearly no high-neck fractures are reported (they are typically classified as type C head fractures) contrary to basal condylar fractures, which are overestimated (nearly all low-neck fractures are classified as basal). The aim of this study is to present a modified AO/SORG classification of mandibular condyle fractures.

Material and methods A new arrangement of the reference lines is proposed because the fracture lines are mainly oblique in this region. The proposed classification was validated using a series of 84 cases that were treated surgically.

Results The diagnoses using the proposed new classification system significantly differed from those based on the old system ($p < 0.005$). All basal fractures in the new classification system were also classified as basal in the old system. The same was true for type C head fractures. The differences were found for low-neck fractures (4 of 84 diagnoses differed between the old and new classifications, i.e., they were previously classified as basal fractures) and high-neck fractures (3 of 84 fractures were diagnosed as low-neck fractures or type C head fractures using the old classification).

Conclusion The epidemiology of the condyle injury should be based on a classification, which reveals types of fractures which are represented by factually and frequently observed cases. That is why a relatively common AO/SORG classification can be modified for the benefit of assessing incidences of high-neck and low-neck fractures.

Clinical relevance Considering that the treatment of the high-neck fractures is much technically complicated than the low-neck ones, this will have an influence on the management of trauma to the area.

Keywords Condyle of mandible · Fracture · Classification

Introduction

For the last decade, the classification/nomenclature of fractures of the mandibular condyle region has been based on the Strasbourg Osteosynthesis Research Group [1] and Arbeitsgemeinschaft für Osteosynthesefragen (AO) systems [2]. The accurate anatomical description of the classification allows for visualization by most clinicians without the need to memorize numerically ordered types of fractures. Some authors believe that the subjective descriptions of “high” and

“low” level fractures in the neck region should be clarified [1, 3]. A new classification system was retrospectively analyzed in a cohort of patients with condylar fractures and found to be simple to use and helpful in the prediction of treatment needs and outcomes [4].

Unfortunately, as this classification was implemented, it became obvious that nearly all fractures were classified as condylar basal and head fractures. Practitioners had to deliberate to determine whether a third or half of the fracture line was above or below the reference. Ultimately, high-neck fracture disappeared as a classification result. The maintenance and utilization of this fracture classification is important due to the special techniques and fixation materials that are required to treat such high fractures that are still not classified as type C head fractures [5].

The purpose of this study is to present a modified classification of mandibular condyle fractures.

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Material and methods

The modification of the current classification of mandibular condylar fractures requires the introduction of two landmarks:

1. The first landmark is the line oblique to the sigmoid notch line (known line, designated line A by Loukota), which was selected because the majority of fracture lines are oblique in this region [1]. This line (the proposed line B) runs along the most prominent point of the posterior border of the masseteric tuberosity and the deepest point of the sigmoid notch.
2. The second landmark is the head anterior border point (Fig. 1), which was selected to establish a recognizable border between the mandibular head and the condylar neck; this border was not clearly established in the old classification system [2]. The point is situated at the top

of the angle of the sigmoid notch immediately below the condylar head, as observed from the lateral view. This point marks the anterior boundary of the head and neck in the lateral view of the mandible.

The proposed classification consists of the same fracture names as the previous system (Fig. 2). When the majority of the fracture line runs over line B in the lateral view, the fracture involves the base of the condylar process and is categorized as a basal fracture. Next, a line parallel to line B is drawn through the head anterior border point. If one divides the space between these lines in half (by the next line parallel to line B), the border between the base region and the lower neck is defined. A condylar low-neck fracture is assigned if more than half of the fracture line runs above this line (observed on the lateral view). If a fracture is mainly located above the line

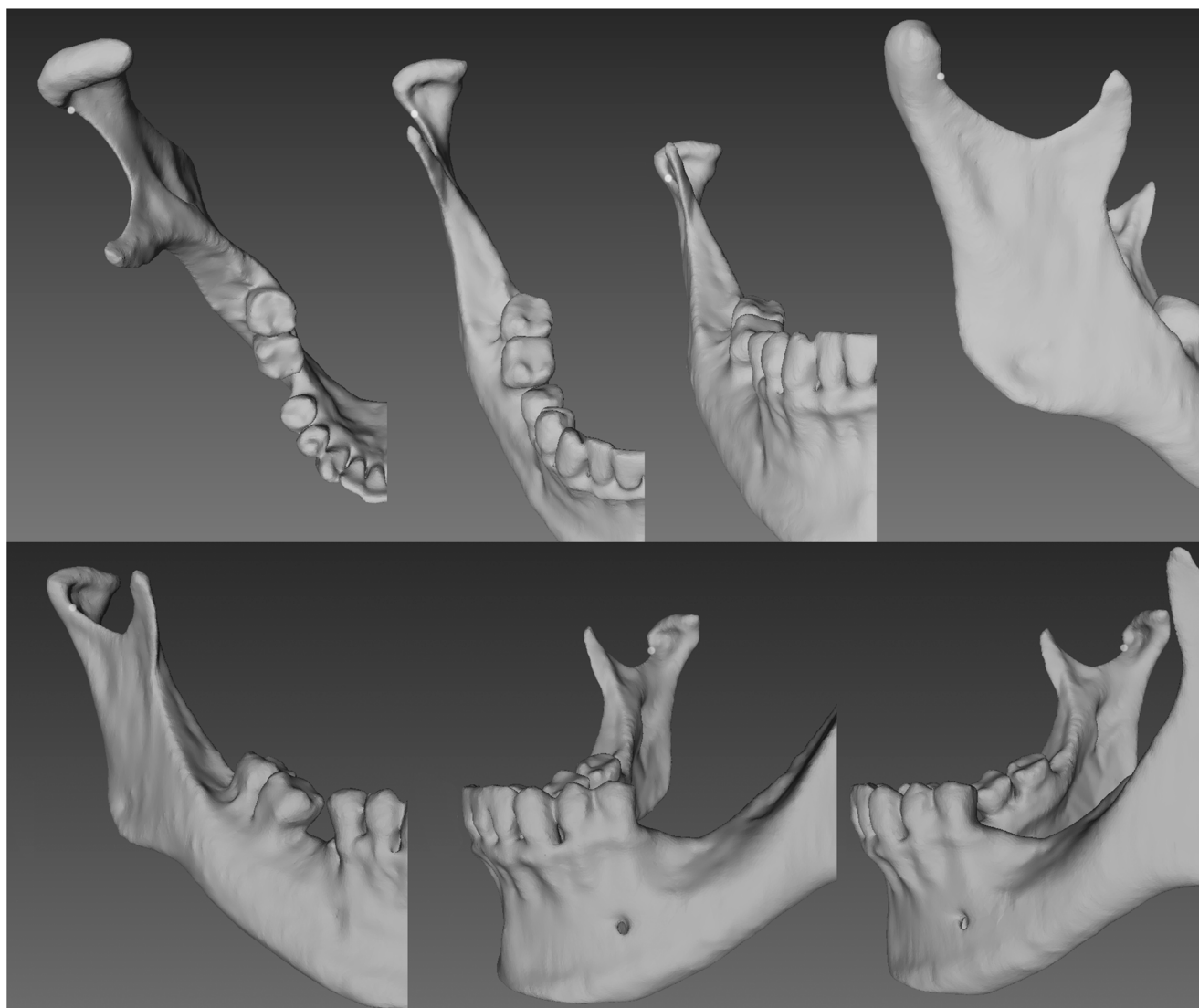


Fig. 1 The head anterior border point. The anatomical localization is in the posterior part of the sigmoid notch at the top of the angle of the sigmoid notch immediately below the condylar head as observed in the lateral view. This point is at the border between the mandibular head and the condylar neck

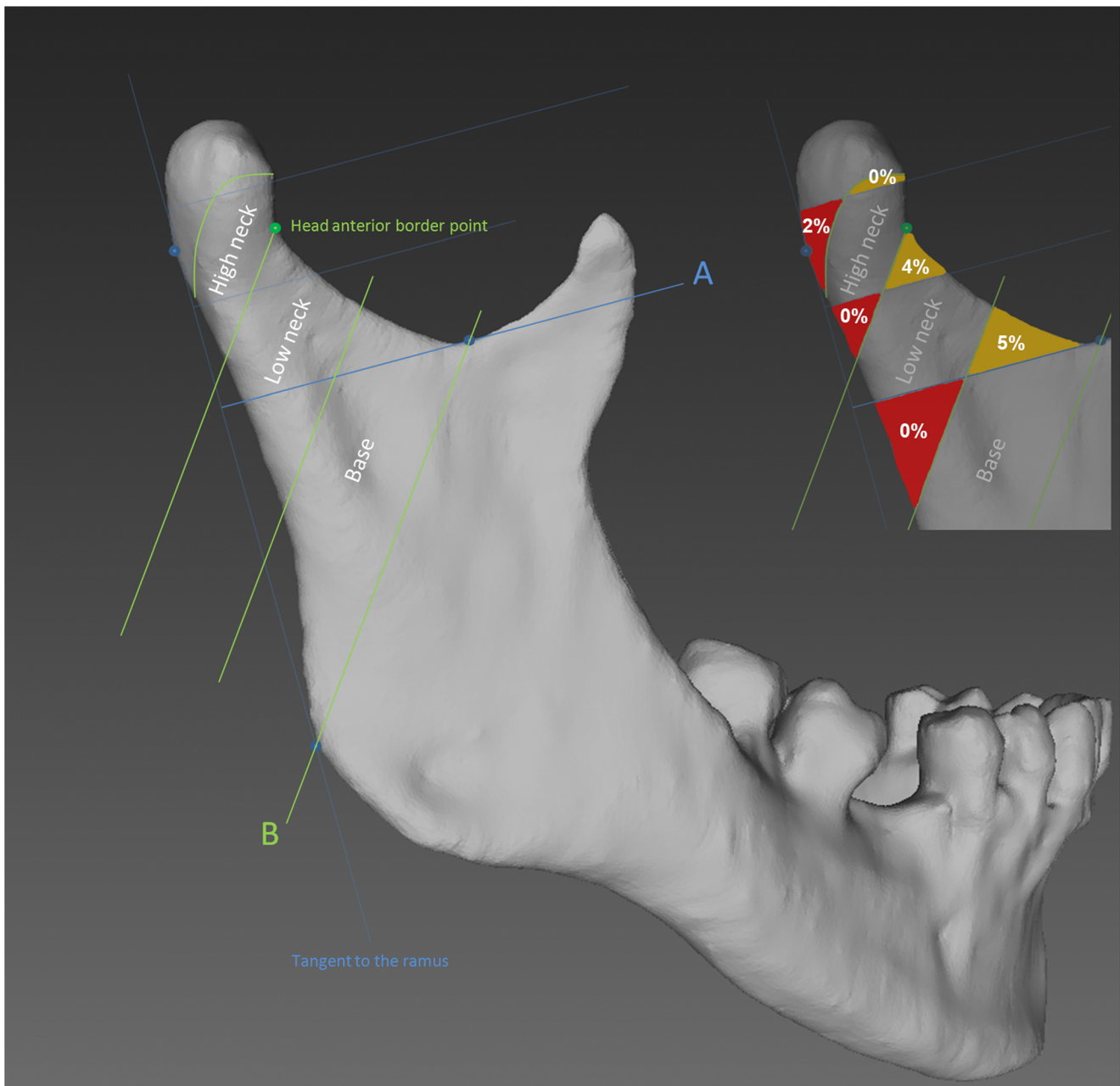


Fig. 2 The modification of the classification of mandible condyle fractures based on oblique reference lines. A, the sigmoid notch line (Loukota's line). B, the line runs along the most prominent point of the posterior border of the masseteric tuberosity and the deepest point of the sigmoid notch. The blue points/lines are the guidelines for the current

running by the head anterior border point and below the type C head fracture line, then it is defined as a high-neck fracture. Normally, the high-neck fissure is oblique (running from high laterally to low medially); thus, a large portion of the neck is in the medial part and still connected to the mass of the mandibular head.

The change in the angle that serves as the basis for coding the condyle fracture was checked in relation to Loukota's line in a series of 362 computer tomographic (CT) scans (102 cone

nomenclature, and the green points/lines are those for the new, modified classification. The yellow area represents possible upward classification transfer, and the red area represents possible downward classification transfer

beam CTs and 260 fan beam CTs). That series contained mandible images from healthy patients of both sexes, whose CTs were retrospectively found in a hospital database. One-way analysis of variance was performed to determine the variability of this angle.

The efficacies of the current and the newly proposed classification systems were retrospectively evaluated based on 95 CT images of mandibular condyle fracture cases that included the following: 60 basal fractures (according to the current

classification) vs. 56 (according to the new, modified classification), 9 low-neck fractures (according to the current system) vs. 12 (according to the modified system), 4 high-neck fractures (according to the current system) vs. 7 (according to the modified system), 11 type C head fractures (according to the current system) vs. 9 (according to the modified system), 10 type B head fractures (according to both classifications), and 1 type A head fracture (according to both classifications). The compatibility of the proposed and modified classification systems was examined with a χ^2 test of independence. Statistical tests were performed with Statgraphics Centurion XVI, Statpoint Technologies, Inc., The Plains, VA, USA.

Results

The proposed change of an angle upon which the coding of the condyle fracture was based was $52^\circ \pm 5^\circ$ in relation to Loukota's line (line A). The distribution of the angle's values was normal. The minimum was 37° , and the observed maximum was 69° . The value was statistically independent of age; the age was 44 ± 18 years (typical for young adults with facial injuries). The value of the angle was also independent of sex (ANOVA $p > 0.05$) and CT data acquisition method independent (ANOVA $p > 0.05$).

The head anterior border point is generally highly recognizable ($>97\%$ of cases). Total agreement was noted in the type A and B head fractures in both classifications because the modification did not concern this type of injury. Thus, 11 cases were excluded from later analysis. Notably, only four high-neck fractures were diagnosed among the included cases according to the conventional classification; in contrast, seven high-neck fractures were diagnosed using the proposed modification.

Observed incompatibilities between the classifications of the fracture levels covered by the modification (i.e., type C head fractures and high, low, and basal condylar fractures) were recognized. The classifications shifted upward from basal fractures (according to the current system, i.e., Loukota et al. 2005 [1] and Neff et al. 2014 [2]) to low-neck fractures in four cases and from low-neck (according to the current system) to high-neck fractures in one case. Downward classification shifts were observed only from type C head fractures (diagnosed according to the current system) to high-neck fractures diagnosed according to the modified system (two cases). No classification changes occurred from basal condylar fractures (according to the current classification) to mandibular ramus fractures, from low-neck to basal fractures, from high-neck to low-neck fractures, or from high-neck (according to the current classification) to type C head fractures. The modified and current classifications fully corresponded only for

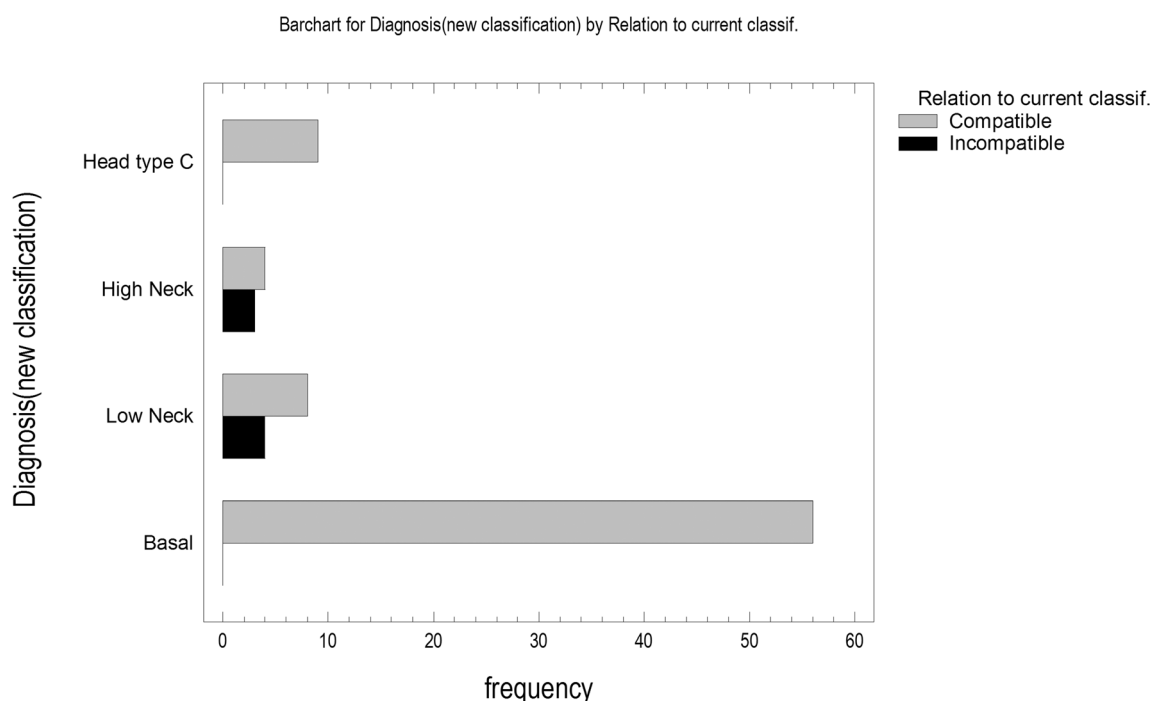


Fig. 3 The effect of the application of the modified classification of mandibular condyle fractures. The new classification strengthens the diagnoses of low- and high-neck fractures ($p < 0.005$). The “incompatible” class indicates migrations of the diagnoses from basal

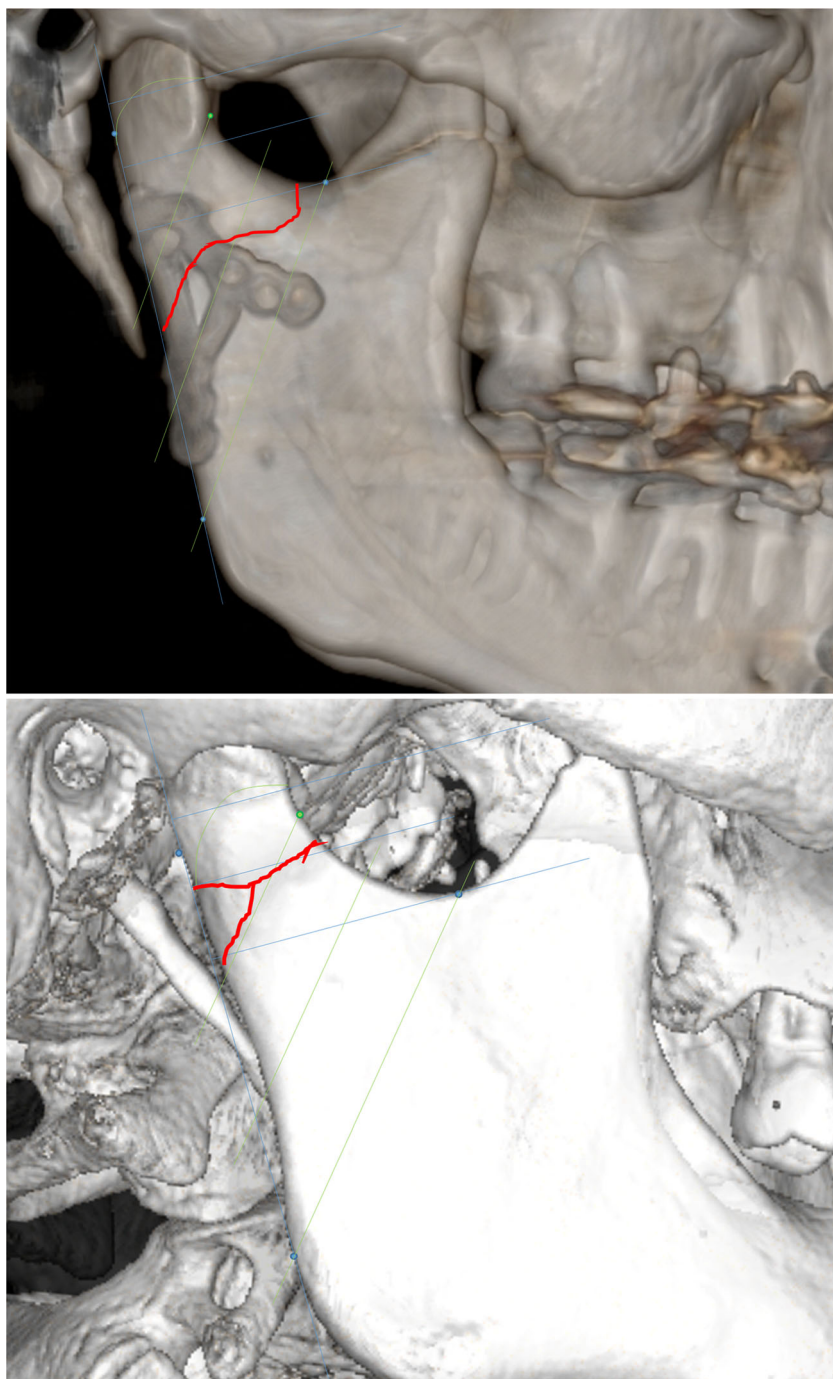
condylar fractures (according to Loukota et al. 2005 [1] and Neff et al. 2014 [2]) to low-neck fractures and from low-neck fractures and type C head fractures in the current system to high-neck fractures in the proposed classification

Table 1 The frequency of diagnosed fractures according to current [1, 2] and proposed classification of mandibular condylar fractures

Fractures	Classification	
	Current (%)	Modified (%)
Head type C	13	11
High neck	5	8
Low neck	11	14
Basal	71	67

basal fractures, i.e., all basal fractures according to the modified classification were also basal in the current classification. The same was observed for the type C head fractures. The following incompatibilities were found (Fig. 2): 5% of low-neck fractures (4 cases out of 84) were previously diagnosed as basal fractures using the current classification, and 4% of high-neck fractures (3 cases out of 84) were recategorized, mainly as low-neck fractures, when the proposed classification system was used.

Fig. 4 Examples comparing the proposed classification (green reference lines and point) to the current classification (blue reference lines and points), which demonstrate the upward classification shifts. Fracture line marked in red. Top: a basal (current classification) vs. a low-neck fracture according to the proposed classification. The postoperational situation is presented. Bottom (superimposition of the intact side on the affected side): a low-neck fracture (according to the current classification) and according to the proposed classification, this is a high-neck fracture. The preoperational situation is presented.



The diagnoses differed significantly (Fig. 3, Table 1) between the proposed modification and the current classification ($\chi^2 = 25.649$, $df = 3$, $p < 0.005$).

Discussion

According to the clinical perspective, a condylar process fracture is defined as any fracture that is situated over the foramen mandibulae and runs from within or above the angle of the mandible into the sigmoid notch or the condylar head. Numerous classifications exist [6–8]; however, this subclassification has always been confused by homonymic classifications that are restricted to the condylar neck region (i.e., the collum mandibulae, according to its anatomical definition) and the use of the homonymic classification terms for completely different fracture levels in papers worldwide. This spectrum of classifications that coexists on an international level makes comparisons between treatment outcomes nearly impossible [9] and highlights the need for a validated classification system based on reproducible anatomical landmarks.

The assumption of this modification is that the reference lines run obliquely because the fracture lines observed in clinical conditions are also oblique. Because the reference lines are mostly parallel to the fracture lines, the fracture levels will be more accurate in the new classification system, and thus this classification will be more coherent with nature.

The advantages of this classification system are as follows: ease of application (as explained previously), simple criteria for the assignment of a fracture to a defined level (because the reference lines run approximately parallel to the fracture lines that are clinically observed), and diagnoses of high-neck fractures along with low-neck fractures can be established. Moreover, the new classification system makes diagnoses more differential. Practitioners will be able to frankly identify three classes of fractures situated below the mandible head; in contrast, in the current system, only basal condylar fractures and head condyle fractures are observed.

However, the new system is still too simple to encompass the entire spectrum of observed clinical variations in fracture lines [2]. As a fracture line runs higher along the processus condylaris, its angulation changes. In those cases, neither the current reference lines nor the proposed, new, modified lines fulfilled the variability (Fig. 4). Some atypical fractures are responsible for disagreement among groups of experts, for example, vertical fractures involving several levels of the condylar process [10]. Such fractures involving the condylar head and extending vertically to the condylar neck (potentially even involving the base) compose a low percentage of all mandible condylar fractures [11]. Coding systems exist that allow for the unambiguous identification of these single fractures as opposed to double fracture patterns involving both the head and neck.

These systems are consistent with the rest of the mandibular system when fractures extend over several regions [12].

Another disadvantage of the proposed classification is the need for additional anatomical point and topographical lines compared to the previous classification. Moreover, the new classification requires a multicenter systematic evaluation with a large number of cases similar to that which was previously performed [4] because it is very difficult to perform reliable and useful comparisons between results in meta-analyses [13].

Generally, the proposed modification influences low- and high-neck fractures, which are underestimated in the currently utilized classification and should be treated surgically with the application of different materials. Slim profile plates or long compression screws [3] can be effectively applied to high-neck fractures, whereas wider plates should be applied in the treatment of low-neck fractures [4].

This modification of the classification of mandibular condyle fractures should assist and simplify treatment-related decision making and standardize diagnoses in future work within this field of traumatology.

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Compliance with ethical standards

The paper complies with the principles stated in the Declaration of Helsinki “Ethical Principles for Medical Research Involving Human Subjects,” adopted by the 18th World Medical Assembly, Helsinki, Finland, June 1964, and as amended most recently by the 64th World Medical Assembly, Fontaleza, Brazil, October 2013.

Conflict of interest The author declares that he has no conflict of interest.

Ethical permission This research was approved by Medical University review board no. RNN/125/15/KE.

Informed consent A formal consent is not required for this type of study.

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