The Orthopaedic Trauma Association Fracture Classification for Publications and Routine Daily Use
Thomas DeCoster MD1
1. UNM Department of Orthopaedics & Rehabilitation

Introduction
As orthopaedic surgery has evolved, numerous classification systems for various fracture patterns have been developed.1-4 These various fracture classification systems as a whole have lacked uniformity, consistency, or validation of determinability or clinical significance. Each has had a specific way of describing a specific fracture pattern without offering applicability to fractures in other regions of the body. Also, multiple individual classifications exist for similar fracture patterns in the same body region. This lack of uniformity has resulted in an ineffective orthopaedic language and poor standardization, making it difficult to accumulate and interpret meaningful data.

Fracture classification is a useful way to facilitate communication regarding fracture care. It allows us to lump similar injuries and distinguish between dissimilar injuries at a variety of levels. Fracture classification is important for routine clinical use as well as musculoskeletal research. Historically, a wide variety of classifications have been utilized in orthopaedics and each classification has its strengths and deficiencies.6-9 The Orthopaedic Trauma Association used the AO Mueller Fracture Classification to develop a comprehensive systematic illustrated classification that was published in 1996.9-11 I contributed to that work. The OTA Fracture Classification was revised and updated and republished in 2007 as the OTA Fracture and Dislocation Classification Compendium.12 I served on the OTA Classification Committee and co-authored the published compendium. This classification has gained widespread, but not universal, use in the orthopaedic literature, and is gaining acceptance in routine fracture care communication. This article summarizes the basic elements of the OTA Fracture Classification, identifies the attractive features and appropriate applications of the classification, and mentions current problems and future directions.

The OTA Fracture Classification is available and provides a useful standard for reporting of skeletal trauma research.13 The use of standard terminology and scheme of fracture classification allows for a more uniform reporting of data and facilitates understanding comparison and reproducibility of results. It gives the orthopaedic community a common language platform on which to base a scholarly discussion and development of our subspecialty. This standard should be routinely used for reporting of results in orthopaedic trauma journals. The Classification has been developed and adopted by the OTA and the Journal of Orthopaedic Trauma (JOT) and utilization of the Classification is required in the instructions to authors of the JOT.14

The OTA Fracture Classification should also be used for routine fracture communication outside of research and publications. The medical record and other written documents, like radiographic interpretations and operative notes, should utilize the classification.15 The hierarchical organization of the classification allows the fractures to be identified at the appropriate level of specificity. The bone and bone segment, the classification's 2 most basic elements, should always be included when describing a fracture anywhere.

“Femur shaft fracture” is far better terminology than “broken leg” or any number of alternatives. “Femur shaft fracture” is directly specified by the language of the OTA Fracture Classification, which first names the bone and then distinguishes among 3 bone segments for each long bone (proximal, shaft, and distal). This same technique is utilized for the femur, leg (tibia and fibula), humerus, and forearm (radius and ulna). The other regions are the spine, pelvis, hand and wrist, foot, and shoulder girdle (scapula and clavicle) (Table 1).12

Table 1
Advantageous features of the OTA fracture classification system

<table>
<thead>
<tr>
<th>Feature</th>
<th>Advantageous Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive</td>
<td>Radiographically and anatomically based</td>
</tr>
<tr>
<td>Hierarchical</td>
<td>Consistent</td>
</tr>
<tr>
<td>Referenced</td>
<td>Verified</td>
</tr>
<tr>
<td>Current</td>
<td>Alphanumeric shorthand available</td>
</tr>
</tbody>
</table>


Advantages of the OTA Fracture Classification

The OTA Fracture Classification is comprehensive in that it applies to every bone in the human skeleton treated by orthopaedists, as well as every fracture of every bone. This classification includes everything from the clavicle to the distal phalanx of the big toe. Every possible fracture pattern and severity from a nondisplaced crack to segmental comminution is included. The Classification is all inclusive as there are no fractures that do not have a place within the classification. Furthermore, the classification is mutually exclusive in that the definitions allow for a unique identifier for each fracture pattern.12

The OTA Fracture Classification is radiographically and anatomically based. Fractures are classified by their radiographic appearance based on the bone involved, the bone segment involved, and the geometric pattern of the fractures and involvement of specific anatomic structures that can be identified radiographically. For example, the proximal and distal aspects of the long bones are subdivided into 3 types (extra-articular, partial articular, and total articular) based on degree of articular involvement. This consistent basis for classification is in distinction to other classifications or terminology like “mechanism of injury.”

The OTA Fracture Classification is hierarchical in that it starts with the most basic element and extends to as much detail as needed for the purpose of user. The levels of the classification are shown in Table 2. The most basic element is the broken bone (by name), which is then subclassified by the bone segment (e.g., femur shaft fracture). Each bone segment has 3 types, each type has 3 groups (total of 9 categories), each group has 3 subgroups (total of 27 categories), and some subgroups are further subclassified (51 categories). The person utilizing the OTA Fracture Classification can match the level of specificity to the desired purpose. Chapter titles for publications would typically utilize the bone segment level (e.g., “femur shaft fractures”). Bone segment level would also be appropriate for diagnosis in medical records (e.g., “femur shaft fracture, left”). The “type” level of classification might be appropriate for a journal article (e.g., “proximal tibia, total articular fractures”) or clinically for an operative report (e.g., “ORIF of left proximal tibia, total articular fracture”). The group level might be appropriate for reporting a particularly high rate of complication in a journal article (e.g., “post-traumatic arthritis was highest in the total articular proximal tibia fractures with articular comminution”). Clinically, this might be useful within the body of an operative note to detail the articular injury pattern and fixation. The main point of the hierarchical component is that this classification can be utilized at the level of detail appropriate for the user. This feature is lacking in the vast majority of other classifications and makes the OTA Classification much more useful.

The OTA Classification is consistent in that the same techniques are utilized to classify patterns throughout the body. Each long bone is divided into proximal, shaft, and distal. The same technique is utilized to make this distinction (the rule of squares). The types are extra-articular, partial articular and total articular for each of the ends of the long bones. The shaft bone segments are classified into types based on fracture geometry (transverse, oblique, spiral), and groups based on pattern of comminution (none, butterfly, segmental). This consistency allows for easy recall of the classification and improves reliability and reproducibility. The pattern is occasionally modified when clinically indicated, such as using the anatomic landmark of the base of the lesser trochanter to designate the distal extent of the “proximal femur fractures” rather than the rule of squares.

The OTA Classification is referenced, as well as illustrated, in the Journal of Orthopaedic Trauma OTA Fracture and Dislocation Classification Compendium. This standardized reference allows everyone to utilize the same standard that is readily available worldwide. This helps to avoid problems with modification and mal-application that is rampant with the use of other classifications.16 The illustrations and classification directions are particularly helpful to achieve consistent application of the classification. The illustrations can be compared to the radiographs of individual patients to enhance consistency of application of the classification, somewhat independent of language. This level of information is typically absent from other classifications which are generally included as a part of some bigger study of technique or clinical outcome.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Hierarchical levels of the OTA fracture classification system</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element</strong></td>
<td><strong>Bone</strong></td>
</tr>
<tr>
<td><strong>Bone segment</strong></td>
<td><strong>Type</strong></td>
</tr>
<tr>
<td><strong>Group</strong></td>
<td><strong>Subgroup</strong></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td><strong>Other</strong></td>
</tr>
</tbody>
</table>
The OTA Classification is verified. This reference and citation should be used routinely when the OTA Classification is utilized in publications. Another benefit of the referenced classification is that it has been verified. Numerous studies have reported the reliability and reproducibility of particular aspects of the classification. This will save time and space within submitted manuscripts to focus on other important determinants of outcome and relieve the author of developing, reporting, and justifying a unique fracture classification for each article. It will also save time and facilitate understanding on the part of the reader interpreting the results of the study and comparing it to other existing similar studies that use a common language and classification scheme. This enables the reader to focus on the variable parameters (like individual treatment) while maintaining confidence that the treatments are being applied to similar fractures (by OTA classification).

The OTA Classification is current. It was originally published in 1996 and revised and re-published in 2007. This allowed inclusion of new knowledge and the incorporation of new and clinically important concepts with reconciliation with other existing classifications (like the AO Classification). The 2007 version also provides more detail for relatively “neglected” bone segments like the foot and hand and dislocations. It is planned for the 2017 revision of the classification to include the latest scapula fracture classification and other updates from the literature.

There is an alphanumeric shorthand available for the OTA Classification. Each bone is designated with a digit (1 to 9) and each bone segment with a second digit (1 to 3 usually; 1 to 9 in special circumstances). The types are designated with a capital letter (A, B, C usually; occasionally D). The groups are designated with another digit (1 to 3 usually; 1 to 5 in special circumstances), and subgroups by a digit following a period (1 to 3 usually). A total articular (bicondylar) proximal tibia fracture would be designated 41-C3. This 5 digit alpha-numeric code then captures all of the verbiage in a concise manner. However, care should be taken to utilize the alphanumeric code as a shorthand version to optimize effective communication. There is a tendency to go straight to the code and this is not effective communication if the recipient or reader is not familiar with the code or if the code is inappropriately applied. A small typographical error or misunderstanding will result in a gross miscommunication. The alphanumeric designation is most appropriate for research data bases or internal record keeping or communication when conciseness is highly desirable.

Problems with the OTA Fracture Classification

The Classification is not being used optimally as of 2011. The results of a study we completed and submitted for publication reveal that only 38% of fracture articles published in the JOT in 2011 utilized the OTA Classification. This shows that the classification is being used somewhat, but that there is room for improvement. The results also show that only 8% of fracture articles accurately cite the 2007 publication. There is a lot of room for improvement in the rate at which the classification is accurately cited. We believe that accurate citation will improve the accuracy with which the classification is used as authors and readers refer to the standardized publication and not some other version or potentially flawed understanding of the classification.

Utilizing the OTA Fracture Classification

There isn’t much stopping its wider use other than inertia. There is no obvious major impediment to utilization of the OTA Fracture Classification other than the historical inertia of tradition in orthopaedic publishing. We found a low rate of need for another classification in reports from 2011 where some other classification contained clinically important distinctions that were not captured by the OTA Classification. In the uncommon situations where that does exist, the use of 2 different classifications within the same manuscript and a paragraph comparing the reported results are sufficient to capture and report all significant data. Furthermore, this will serve as a directive to future development of the OTA Classification to incorporate clinically significant category designations.

In the future, authors (and reviewers and editors) should make sure it is used and monitor the percentage usage on a yearly basis. We recommend routine utilization of the OTA Fracture Classification in trauma research publication in general, and specifically in study design and grant application and in selection of titles for articles, podium presentations, posters, book chapters, and other scientific communication. In reporting of results and complications, the 2007 reference should always be cited. The percentage of JOT articles utilizing and citing the OTA Classification should be reviewed annually.

Once it is standardized in orthopaedic trauma literature (JOT), a more convincing case for its use in other journals (Journal of Bone and Joint Surgery, Journal of Orthopaedic Research, etc), textbook, and educational literature can be made. When the percentage of articles in JOT that use and cite the OTA Classification is over 90%, then an effort should be made to extend this pattern to JBJS and other orthopaedic journals, textbooks, and educational literature.
There are many benefits to increased frequency of utilization of the OTA Fracture Classification. Utilizing it will improve the quality of our literature and knowledge and facilitate effective communication. Effective communication will be achieved by utilizing standardized terminology. This is important so that similar things are called the same thing and dissimilar things are called by different names. Standardization applies to all levels of the OTA Fracture Classification. This is crucial in the time of computer searches where consistency and standardization is required.

For example, if one wanted to perform a meta-analysis of the literature on treatment of distal radius fractures to determine standard of care it would be useful if a computer search of “distal radius fractures” in the title identified all pertinent articles. It would be less effective if “wrist fractures” or “Colles fracture” or any number of other eponyms or non-anatomic, non-OTA phrases were utilized in the article title. There are many other situations where non-OTA terminology is still commonly used in orthopaedic writing, even publications. “Hip fractures” is a phrase commonly used and seems to apply to proximal femur fractures. But the hip is a joint and not a bone. Acetabular fractures at least involve the hip joint but are not typically included in “hip fracture” series. Trochanteric proximal femur fractures are, by definition, not only extra-articular but outside of the hip capsule, yet they are commonly included in series titled “hip fractures.” This lack of consistency and anatomic accuracy plagues the past orthopaedic literature and is being improved by utilization of OTA Fracture Classification in the title of articles. “Ankle fractures” is another example of common terminology that is not anatomically consistent or correct. “Ankle fractures” does not typically include talar dome fractures, which clearly go into the ankle joint; additionally, the talus is colloquially known as “the ankle bone.” “Ankle fracture” does typically include fracture of the fibula several centimeters proximal to the ankle joint. “Ankle fractures” do not typically include distal tibia plafond fractures, even though the latter involves even more injury to the ankle joint. All of this inconsistency, anatomic inaccuracy, and confusion can be avoided if the OTA terminology is utilized. Talus fractures are identified as just that. The distal tibia and fibula is divided into malleolar pattern (bone segment alphanumeric designation 44) and the plafond (bone segment alphanumeric designation 43).

Standard terminology is helpful for several reasons. The first is that it clearly and uniquely identifies the type of injury that is included in the report. It distinguishes the fracture from other, similar fractures. The terminology is uniquely defined by the OTA Fracture Classification. This contrasts with alternative techniques, like eponyms or other classifications that have been reported but modified and adapted to clinical use, thereby confusing exactly what they mean and how they are applied. Is a Colles fracture any fracture of the distal radius or only the extra-articular dorsally angulated fracture? Is a Schatzker 5 any bicondylar tibial plateau fracture or only the one with an intact central column as originally described by Schatzker? Use of the OTA Fracture Classification terminology overcomes most of those problems, as each term is uniquely defined and every fracture falls in exactly 1 category. The OTA Classification is easily learned, as it uses consistent, anatomically accurate terms that are referenced in a readily available and readable compendium.

The OTA Fracture Classification utilizes clinically important criteria to separate categories. In general, the higher the type and group designation the more severe the injury and the worse the prognosis. A type level example is: extra-articular (A) versus partial articular (B) versus total articular (C). A group level example is comminution: non-comminuted (1), butterfly or “wedge” comminution (2), segmental comminution (3). Numerous publications have supported the prognostic value of specific aspects of the OTA Fracture Classification schemes at the type and group level, and a few at the subgroup level.

The OTA Fracture Classification is also very useful to document less common injuries, like dislocations and fractures of the small bones. The classification of both of these areas were extensively revised and made more consistent and clinically applicable with the 2007 revision. Dislocations are identified by the joint involved (equivalent to bone segment) with the alphanumeric second digit as 0 to indicate dislocation. For example, knee dislocations are designated 40. The types are by direction of the distal part anatomically, thus anterior dislocations are A, posterior B, medial C, lateral D, and other E.

The small bone classification is consistent in the hand and foot with designation of the body part (hand 7 or foot 8), segment (tarsals, metatarsals, phalanges; carpus, metacarpals, phalanges). Tarsal and carpal bone is given a second digit numeric designation (1 - 9) and typed by absence (A) or presence (B) of comminution. Phalanges, metacarpals, and metatarsals are grouped similar to “long bones” into proximal, distal, and shaft. Subgrouping is by comminution.

Conclusion

Utilizing the OTA Fracture Classification will improve the overall consistency and quality of orthopaedic trauma literature and be beneficial to authors, reviewers, editors, and readers. Authors benefit

...
by having established standardized terminology and classification schemes that they merely need to apply to their investigation. They will not have to develop or explain their individualized terminology or scheme. Furthermore, they will have easy access to existing literature by computer searches using standardized terms to direct the development of their own experimental methods and comparative discussion of results. The people who read the articles will also benefit from standardized and well-defined terminology and classification schemes. The standardized terms in the title and abstract will enable the reader to quickly understand which fractures are included. The alternative to the use of standardized language is the use of eponyms and jargon which may be an effective shortcut among a small group of club members who are familiar with the code, but this is not an effective technique for the wide dissemination of scientific knowledge.

The OTA Fracture Classification alphanumeric shorthand can be utilized when appropriate as a concise, elegant form of designation, especially in research settings and internal use situations. However, care should be taken to avoid overuse of the alphanumeric shorthand in more widely disseminated communication (like medical records), as lack of familiarity with the code by other individuals will render this confusing rather than clear communication.

Utilizing the OTA Fracture Classification by standardized referenced words and phrases in routine daily clinical communication will improve the overall consistency, quality, and effectiveness of communication in medical records. Other health care providers (e.g., ward nurses or anesthesiologists) will understand the fracture description by use of standard anatomic terms and referenced phrases. Anyone who does not understand a term can find it in standard texts or dictionaries and can see the particular details of the published classification. The more frequently the classification is used, the easier it will be to remember and understand.

### References


---

**Table 3**

<table>
<thead>
<tr>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective communication</td>
</tr>
<tr>
<td>Standardized terminology</td>
</tr>
<tr>
<td>Efficient computer searches</td>
</tr>
<tr>
<td>Consistency</td>
</tr>
<tr>
<td>Comprehensive</td>
</tr>
<tr>
<td>Understood by all</td>
</tr>
<tr>
<td>Easily learned</td>
</tr>
<tr>
<td>Clinically applicable</td>
</tr>
</tbody>
</table>


