Injury, Int. J. Care Injured 50 (2019) 819–820

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Letter to the Editor

The articular and non-articular proportion in segment classification of tibial plateau fractures

Dear Editor,

Tibial plateau fracture is a hot topic in orthopaedic traumatology in recent years worldwide. Tibial plateau fracture patterns can be classified by its different characteristics, including the anatomic involvement (medial/lateral condyle, column, quadrant, segment), fracture type (split/depression), mechanism (varus/valgus, axial/rotational, flexion/extension, hyper-flexion/hyper-extension,), soft tissue injury (meniscus, ligaments, neurovascular structures), and fracture-subluxation/dislocation of the knee. Integrated classification combines the above features to provide full description of fracture patterns and injury degrees has been attempted, but found to be too complicated to use in clinical practice.

The CT-based classification, including column [1–3], quadrant [4–9], and segment [10–12], focus on the anatomic area from axial, coronal, sagittal and 3D view, strengthen the evidence of the frequent involvement of the posterior tibial plateau fractures, and put emphasis on the posterior coronal fragments, which is indeed an important prognostic factor in tibial plateau fracture treatment.

Recent segmental classification systems as proposed by Krause et al. [10,11] and Yao et al. [12] separate the tibial plateau into articular and non-articular areas. However, to our best knowledge, no anatomical data about the articular/non-articular proportion has been described in literature.

Using Lasso Tool in Photoshop software, we delineate the articular plateau margin and calculate the area proportion in 12 fresh adult specimens (3 paired men and women). With the foot in exact anterior direction, the anterior marginal articular line is approximately parallel to the coronal line, while the posterior line is oblique to the posteromedial direction (Fig. 1).

According to our measurement, the medial articular plateau is about 1 cm longer in anterior-posterior direction than the lateral plateau. The medial and lateral articular surface areas together occupy about 70% of the total tibial plateau surface area, with the medial side of 38% and lateral side of 32%. The medial to lateral articular area ratio is roughly 1.15: 1, which means that the medial articular plateau surface is 15% larger than the lateral one. The central non-articular area occupies about 30% of the total tibial plateau surface, with the intercondylar spine area of 20% and the anterior bare area of 10%. The intercondylar spine area contains cruciate ligament attachments (ACL and PCL) and meniscus horn attachments (medial and lateral). The results are summarized in Table 1.

The detailed segment classification system (8-, 9-, 10-segment) may delineate the tibial plateau fractures more accurately [10–12]. Combined with the knowledge of articular and non-articular area proportion, the fractured part of tibial plateau (articular and non-articular) can be calculated more precisely and proportionally, which is helpful in treatment decision making and preoperative planning.

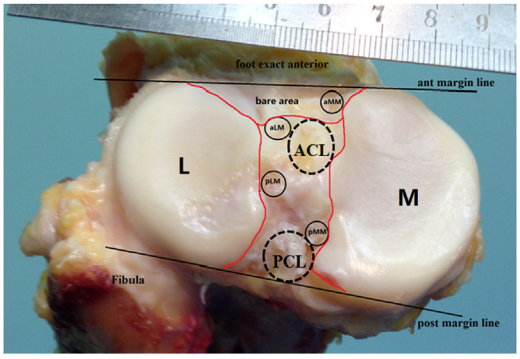

Fig. 1. Anatomic measurement of articular/nonarticular surface area proportion. M: medial plateau, L: lateral plateau; ACL: anterior cruciate ligament; PCL: posterior cruciate ligament; aMM: anterior medical meniscus root; pMM: posterior medial meniscus root; aLM: anterior lateral meniscus root; pLM: posterior lateral meniscus root; solid circle: meniscus root attachments; dotted circle: cruciate ligament attachments

Table 1
Anatomic data of surface area proportion.

Items	Mean ± SD	Min. ~ Max.
Articular area to total tibial plateau surface	(69 ± 4) %	(65–75) %
Medial articular area to total plateau	(37 ± 2) %	(33–41) %
Lateral articular area to total plateau	(32 ± 3) %	(28–34) %
Lateral articular area to total articular surface	(47 ± 3) %	(43–49) %
Medial articular area to total articular surface	(53 ± 3) %	(51–57) %
Medial/lateral articular area ratio	1.16:1	(1.03–1.36):1
Nonarticular area to total plateau surface	(30 ± 5) %	(23–33) %
Intercondylar area to total plateau	(20 ± 3) %	(16–23) %
Anterior bare area to total plateau	(11 ± 3) %	(7–14) %

Conflict of interest

The authors declare that they have no conflict of interest about this paper.

https://doi.org/10.1016/j.injury.2019.01.021

Funding

The study was supported by funding from National Nature Science Fund of China (NSFC No. 81873989) and Shanghai Municipal Science Committee (No.17411971400).

References

[1] Luo CF, Sun H, Zhang B, Zeng BF. Three-column fixation for complex tibial plateau fractures. J Orthop Trauma 2010;24(11):683–92, doi:http://dx.doi.org/10.1097/BOT.0b013e3181d436f3.
[2] Wang Y, Luo C, Zhu Y, Zhai Q, Zhan Y, Qiu W, et al. Updated three-column concept in surgical treatment for tibial plateau fractures–a prospective cohort study of 287 patients. Injury 2016;47(7):1488–96, doi:http://dx.doi.org/10.1016/j.injury.2016.04.026.
[3] Hoekstra H, Kempenaers K, Nijs S. A revised 3-column classification approach for the surgical planning of extended lateral tibial plateau fractures. Eur J Trauma Emerg Surg 2017;43(5):637–43, doi:http://dx.doi.org/10.1007/s00068-016-0696-z.
[4] Chang SM, Hu SJ, Zhang YQ, Yao MW, Ma Z, Wang X, et al. A surgical protocol for bicondylar four-quadrant tibial plateau fractures. Int Orthop 2014;38(12):2559–64, doi:http://dx.doi.org/10.1007/s00264-014-2487-7.
[5] Dhillon MS, Patel S, KP. Simple four column classification can dictate treatment for intra articular tibial plateau fractures much better than ten segment classification. Injury 2017;48(6):1276–8, doi:http://dx.doi.org/10.1016/j.injury.2017.03.031.
[6] Krause M, Frosch KH. Response to the letter-to-the-editor by Dhillon et al. "Simple four column classification can dictate treatment for intra articular tibial plateau fractures much better than ten segment classification". Injury 2017;48(10):2369–70, doi:http://dx.doi.org/10.1016/j.injury.2017.07.040.
[7] Hoekstra H. Are there four tibia plateau columns? Int Orthop 2017;41(12):2631–2, doi:http://dx.doi.org/10.1007/s00264-017-3602-3.
[8] Krause M, Menzdorf L, Preiss A, Frosch KH. Are there four tibial plateau columns? Yes there are, as illustrated by a postero-lateral apple-bite fracture. Response to a letter-to-the-editor. Int Orthop 2018;42(2):443–6, doi:http://dx.doi.org/10.1007/s00264-017-3686-9.
[9] Chang SM, Hu SJ, Du SC, Ma Z, Xiong WF, Yao XZ. Four-quadrant/column classification of tibial plateau fractures. Int Orthop 2018;42(3):725–7, doi:http://dx.doi.org/10.1007/s00264-017-3733-6.
[10] Krause M, Preiss A, Meenen NM, Madert J, Frosch KH. 'Fracturoscopy' is superior to fluoroscopy in the articular reconstruction of complex tibial plateau fractures—an arthroscopy assisted fracture reduction technique. J Orthop Trauma 2016;30(8):437–44, doi:http://dx.doi.org/10.1097/BOT.0000000000000569.
[11] Krause M, Preiss A, Müller G, Madert J, Fehske K, Neumann MV, et al. Intra-articular tibial plateau fracture characteristics according to the "Ten segment classification". Injury 2016;47(11):2551–7, doi:http://dx.doi.org/10.1016/j.injury.2016.09.014.
[12] Yao X, Xu Y, Yuan J, Wang L, Fu X, Lv B, et al. Classification of tibia plateau fracture according to the "four-column and nine-segment". Injury 2018;49(12):2275–83, doi:http://dx.doi.org/10.1016/j.injury.2018.09.031.

Rujan Tuladhar
Sun-Jun Hu
Shi-Min Chang*
The Department of Orthopaedic Surgery, Yangpu Hospital, Tongji University School of Medicine, Shanghai 200090, People's Republic of China

* Corresponding author: Department of Orthopedic Surgery, Yangpu Hospital, Tongji University School of Medicine, 450 Tengyue Road, Shanghai, 200090, People's Republic of China.
E-mail address: shiminchang11@aliyun.com (S. Chang).