CT Scan Necessary for Ankle Fracture Surgical Management and Post-Operative Care

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Abstract

The aim of this study is to support the routine use of CT scans in both high and low energy ankle fractures to enhance surgical fixation management and post-operative protocol. 8 foot and ankle surgeons were provided a series of questions regarding their preferred course of surgical treatment and post-operative management of 25 ankle trauma cases based solely on X- ray; then again asked to describe their preferred course of treatment based on CT. Cases were randomized, providing a total of 400 paired results for data comparison.

Statement of Purpose

The goal of this study is to demonstrate the role of computerized tomography (CT) for traumatic ankle fractures, and its influence on decisions for fixation constructs, surgical approach and post- operative management.

Level of Evidence

Level III, Scientific

Literature Review

Ankle joint is a complex ginglymous joint composed of various articulating surfaces and ligaments from tibia, fibula and talus. Appropriate anatomic reduction following acute ankle trauma has been shown to give better patient long-term satisfactory results with decreased post-traumatic osteoarthritis, ankle instability, decreasing patient morbidity and reducing overall healthcare cost associated with the subsequent treatment of post-traumatic ankle arthritis. Fracture identification, interpretation of morphology of fracture fragments, and articular incongruency when assessing with plain radiographs is insufficient which may result to inadequate anatomic reduction. CT scans provide necessary 3-dimensional morphology to understand ankle fracture patterns, and thereby necessary for operative planning and guide post-operative management.

Methodology & Procedures

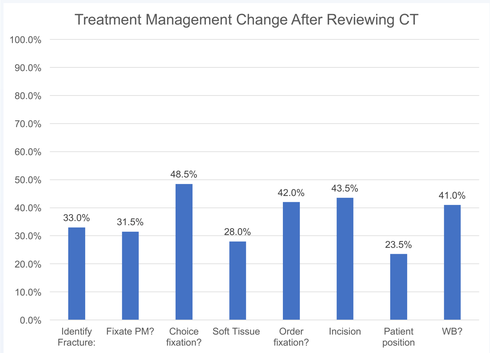
- 8 foot and ankle surgeons were given a sequence of questions for 25 skeletally mature X-ray ankle trauma cases, followed by 25 corresponding randomized CT scans of the same patients (Total of 50 radiographic films).
- Series of questions inquired regarding osseous fracture identification, surgical treatment management including choice of fixation, posterior malleolus fixation, order of fixation, incision approach, and patient position on operative table, and post-operative management for both X-ray and CT cases.
- The same series of questions were provided for each plain radiograph and corresponding CT cases and the differences of management were recorded.
- CT scans were advanced imaging correlated with the X-Ray ankle trauma cases and were randomized when surgeons were asked to evaluate.
- X-Ray standard 3 view series were provided (DP, MO, Lateral views), and full CT scan to ensure proper evaluation.
- A total of 400 paired results for data comparison were obtained.
- We collected radiographic data from our hospital database September 2020 to May 2013, and all 25 skeletally mature ankle fracture cases received X-ray films along with advanced CT scans.

Figure 1. Plain Radiograph with Corresponding CT Image from Our Study

Results

25 ankle trauma plain films reviewed, followed by CT imaging by 8 surgeons (n=200): (Table 1)

- 33% (66/200) change in fracture diagnosis
  - 92.4% (61/66) of these were increased malleolar diagnosis
- 48.5% (97/200) change in fixation plan
- 31.5% (63/200) posterior malleolar fixation modification
- 42.0% (84/200) change in order of fixation
- 43.5% (87/200) incision placement adjustment
- 23.5% (47/200) patient position change
- 41% (82/200) post-operative management altered with increased non-weightbearing status secondary to identification of complexity of fracture after reviewing CT



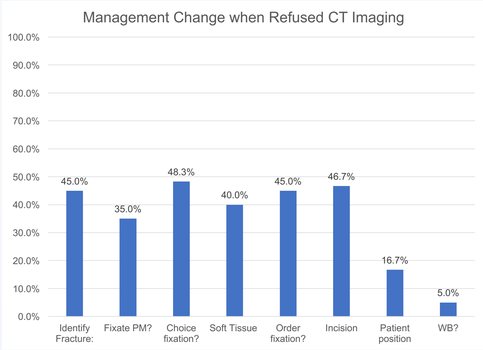
Disclosures

None

Results (Continued)

Cases surgeons refused CT scans from original plain film review (n=60):

- 45% (27/60) osseous fracture identification
- 48.3% (29/60) fixation management adjustment
- 35% (21/60) increase in posterior malleolus fixation
- 45% (27/60) change in order of fixation
- 46.7% (28/60) incision placement adjustment
- 16.7% (10/60) patient position change
- 35% (21/60) increased post-operative non-weightbearing duration post-operatively



Analysis & Discussion

Computed tomography (CT) scan provides the ability of practitioner to accurately assess essential information regarding configuration of fracture fragment and heavily aids on deciding optimal approach for fixation which may concomitantly affect post-operative management (3). Surgeons who refused CT scans from initial evaluation on plain radiographs revealed 45% modification of fracture identification, which concomitantly resulted to 48.3% change of fixation management, 35% increase in posterior malleolar fixation, and 35% increase in post-operative non-weightbearing protocol. It should be emphasized the significant difference in surgical management and post-operative protocol in these cases if surgeons decided to order a CT scan after initial evaluation of plain film.

Analysis & Discussion (Continued)

With a CT scan that provides surgeons with 3-dimensional morphology imaging, a more definitive fracture diagnosis will accordingly result in a surgical plan that will promote stable anatomic reduction eliciting higher patient satisfaction and less probability for post-traumatic osteoarthritis and future additional surgeries.

No consensus exists regarding minimal size of a posterior malleolus fracture fragment requiring fixation, however with a CT provided surgeons with better morphology of fragment lead to 31.5% fixation increase once reviewed. For surgeons who refused CT from initial X-ray evaluation, an increase of 35% posterior malleolar fixation was found in our study reinforcing the notion it is difficult to identify posterior malleolar fracture on a true lateral plain radiograph. Because of the anterior curve of the posterior tibia, on a true lateral radiograph a posterior malleolus fracture can not only be underestimated but also be barely visible (Figure 1) (10). Posterior malleolar surgical reduction restores ankle joint congruity and achieves indirect stabilization of syndesmosis via ligamentotaxis of posterior inferior tibiofibular ligament.

Post-operative management weight-bearing status demonstrated significant increase in non-weightbearing protocol of 41% once complexity of fracture morphology was precisely identified following review of CT. It is worthy to note the most significant variation in our collected data was fixation management (48.5%) as result from 33% modified fracture diagnosis, 92.4% of these diagnosis adjustments being increased malleolar involvement. Based off our data, pre-operative CT is underutilized, and paramount in providing superior detail of the fracture pattern, joint congruity, and periarticular injuries where evaluation with plain radiographs may misrepresent or under estimate the nature, extent, and severity of injury.

References

1. Irwin, Todd A., John Lien, and Anish R. Kadakia. "Posterior malleolus fracture." *JAAOS-Journal of the American Academy of Orthopaedic Surgeons* 21.1 (2013): 32-40.
2. Haraguchi, Naoki, et al. "Pathoanatomy of posterior malleolar fractures of the ankle." *JBJS* 88.5 (2006): 1085-1092.
3. Tejwani, Nirmal C., Brian Pahk, and Kenneth A. Egol. "Effect of posterior malleolus fracture on outcome after unstable ankle fracture." *Journal of Trauma and Acute Care Surgery* 69.3 (2010): 666-669.
4. Xu, Hai-lin, et al. "A retrospective study of posterior malleolus fractures." *International orthopaedics* 36.9 (2012): 1929-1936.
5. Solan, M. C., and A. Sakellariou. "Posterior malleolus fractures: worth fixing." *The bone & joint journal* 99.11 (2017): 1413-1419.
6. Donohoe, Steven, et al. "Impact of computed tomography on operative planning for ankle fractures involving the posterior malleolus." *Foot & ankle international* 38.12 (2017): 1337-1342.
7. Sheikh, Hassaan Q., et al. "The effect of computerised tomography on operative planning in posterior malleolus ankle fractures." *Foot and Ankle Surgery* 26.6 (2020): 676-680.
8. Kumar, Ashwani, et al. "Effect of CT on management plan in malleolar ankle fractures." *Foot & ankle international* 39.1 (2018): 59-66.