

## The Diagnosis and Initial Management of Injury to Lisfranc's Joints in the Primary Care Setting in South-Eastern Ontario: How are we Doing?

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### Abstract

**Objectives:** Subtle injuries to the Lisfranc's joint complex (or LFIs) can be difficult to diagnose on initial presentation to the primary care physician (or PCP). Significant research has gone into subspecialty imaging and operative management of LFIs. Little research, unfortunately, has gone into how PCPs, who are typically most initially suspect, and ultimately diagnose LFIs initially, perform when seeing cases typical of LFIs.

**Methods:** A survey that assessed the diagnostic accuracy and management of LFIs in PCPs in Ontario was designed and validated. A final survey was circulated, via mail, to PCPs in southeastern Ontario. 189 of the 851 (22.2%) contacted PCPs responded to the survey. Demographic data was collected and compared to available information to ensure a representative sample.

**Results:** With reference to subtle LFIs, A misdiagnosis of "soft tissue sprain" was made 35% of the time, while only 17% of respondents were able to correctly identify the unstable nature of the injury. 54% of responding PCPs indicated follow-up with an orthopaedic surgeon within the recommended two weeks.

**Conclusions:** A directed educational intervention aimed at teaching PCPs in Ontario the principles for diagnosis and management of LFIs is indicated. These interventions may potentially help in increasing understanding and increasing the level of clinical suspicion when presented with the clinical scenario that can be associated with LFIs.

**Keywords:** Lisfranc injury; Tarsometatarsal fracture dislocation; Primary care

### Introduction

It is well known that injuries to the medial tarso-metatarsal articulation, or simply "lisfranc injuries" (or lfi) as they are commonly called; often go undiagnosed at initial presentation due to their deceptively normal appearing radiographs [1]. this is due, in most part, to the stability imparted on the midfoot by its anatomy [2]. This can result in a near anatomic radiographic relationship of the non-weight-bearing midfoot, even in the face of significant ligamentous disruption [1,3] adding to the subtlety of the injury is the low energy mechanism that can accompany this deceptively devastating injury. Unsuspecting injuries, which can be a result of a rotational mechanism, (e.g. the midfoot rotating over the edge of a street curb while a patient suffers a low energy mechanical fall) can result in significant ligamentous injury to the tmt joint complex [1,3] such low-energy trauma can then lull the initial treating physician, which is often a primary care physician (or pcps), into a false sense of relative security. This can lead to the misdiagnoses of patients with a lfi. It is therefore paramount for any initially treating physicians, including pcps, to maintain an extremely high level of suspicion when a patient

complains of inability to weight bear on a painful, swollen midfoot after suffering a minor rotational mechanism of injury [3].

In lfi cases where the initial diagnosis is missed, mid-foot instability often develops into a painful, rigid planovalgus deformity [4]. This may lead to rapidly progressive osteoarthritis of the tmt joints. [1] These conditions are often refractory to operative management and in most cases, lead to chronic pain, losses in working productivity and large compensation claims [5]. This is in contrast to the relatively acceptable outcomes that patients can expect if a timely diagnosis and operative stabilization is achieved in less than 4-6 weeks [1]. It is for this reason that medical-legal claims are also not uncommon when a lfi has been missed [5]. This highlights the importance of a healthy respect for the subtle presentation and the gravity of lfis.

Although much research has been aimed at the accuracy of various imaging modalities, the results of operative fixation, and the poor outcomes after missed diagnosis, [1,3-9] little study has gone into assessing what role pcps potentially play in the missed diagnoses of subtle lfis. The purpose of this cross-sectional survey study was to assess the level of knowledge and comfort in assessing subtle lfis by pcps in southeastern Ontario, Canada.

## Methods

### Development of a validated survey

A survey was developed by an orthopaedic resident (DJM), an experienced orthopaedic surgeon (mmh) and survey psychologist (rrh) and piloted on a group of residents, family physicians emergency room physicians and orthopaedic surgeons. Three fellowship-trained foot and ankle surgeons also completed the survey, with a resultant "perfect score," indicating that agreement amongst experts regarding "correct" answers was very high. The survey was then evaluated for face and content validity. Further, coefficient alpha reliability measures were calculated to establish acceptable levels of internal consistency, and a test-retest correlation was used to ensure temporal reliability.

The result was a 24-question survey divided into six parts. The first part consisted of demographic questions relating to level of training as well as details of the practice environment and experience. The remaining five sections presented case scenarios with a brief history, along with a non-weight bearing plain film radiograph of the foot and ankle. Three of the five scenarios presented lfis. Two were classified as "subtle" lfis, and were the cases of interest (Figure 1) one scenario depicted a much displaced crush-type lfi. Two scenarios depicted non-lfi foot trauma cases to prevent any pattern recognition in the candidates' responses. One scenario depicted a talus fracture, one an uninjured foot. Each case scenario was followed by eight questions with a selection of answers to choose from. The questions were divided into "diagnosis" and "management" sections. For the diagnosis section, participants were asked to locate and diagnose the injury, to indicate the dislocated joint and whether the injury was intra or extra-articular (or both), to comment on the presence and degree of displacement, and to assess the theoretical stability of the injured foot. For the management section, candidates were asked to determine if a reduction was needed, and to choose the type and timing of follow-up required. Finally, participants were asked to comment on how confident they felt treating the patient in that particular scenario.

**Case description:** You are a doctor practicing in a community hospital with minimal orthopaedic support. An otherwise healthy 25 year old male felt with a bicycle accident in which he fell from his moving bicycle onto his right foot. He has no other injuries. He is currently complaining swelling and pain in his foot. He has no medical history of note. He is currently not taking any medications. He has a known allergy to penicillin. Examination reveals a tender, mildly swollen midfoot with no gross deformity. The foot is neurovascularly intact. There is no laceration or wound. The patient can weight-bear but has a markedly antalgic gait, and will only take 2 steps at a time. The ankle joint is normal and can be out through a normal range of motion with no pain. Examination of his hindfoot is painless, examination of his mid-foot is painful and he isolates the pain (rated 5/10) to the centre of his midfoot. Examination of his forefoot is relatively painless with only pain referred from his midfoot. You order non-weight bearing plain film radiographs. The provided film was obtained.



**Figure 1:** A sample case utilized in the web-based scenarios. This represented one of the low-energy lisfranc's joint injuries presented (with a positive radiographic fleck sign present).

### Collection of survey data

The study was approved by the queen's university ethics review board. Utilizing the college of physicians of Ontario online directory ([www.cpso.on.ca](http://www.cpso.on.ca)), all those indicating an active practice in emergency medicine and family medicine in southeastern Ontario were identified. They were then invited to participate in the study utilizing the supplied business mailing address provided. Data collection occurred from October 1, 2009 until December 31, 2010. Instructions to access the online link to the survey (managed by [www.surveymonkey.com](http://www.surveymonkey.com)), complete and return the survey were sent to attending staff practicing under the titles of family medicine and emergency medicine. Participants were informed that, following reading the supplied letter of information, the completion and return of the survey implied informed consent to use their anonymized data for research purposes. Demographic data on primary care physicians currently practicing in Ontario were obtained from the Ontario medical association via direct e-mail correspondence, as the data remains unpublished, for comparison to ensure a representative sample.

### Respondents

189 of the 851 (22.2%) contacted pcps responded to the survey. Of those, 114 completed the survey in its entirety. The other partial responses were not used in analyses. This represented a response rate of 13.4%. Descriptive data are summarized in table 1. Based on email correspondence from the Ontario medical association head office, the collected sample was representative. 71% of the cohort was comprised of family medicine physicians and 29% were emergency medicine physicians. The majority (83%) of the studied family doctors was certified from the college of family practice of Canada (or ccfp), while

a minority (17%) was licensed to practice family medicine based on a rotating internship completion. Of the studied emergency room-based physicians, 66% had completed their ccfp plus a fellowship in emergency medicine (ccfp em), while 34% had completed the royal college training program in emergency medicine.

	N	%
<b>Educational Background</b>		
Family Medicine (CCFP/rotating internship)	81	71
Emergency Medicine	33	29
<b>Practice Setting</b>		
Academic Facility	27	24
Community Facility	84	76
<b>Practice Location</b>		
Predominantly (>50%) Emergency Room/Urgent Care	21	21%
Office practice with regular emergency room shifts	28	29%
Predominantly Office Setting	49	50%
<b>Time In practice</b>		
<10 years	55	49%
10-20 years	20	18%
>20 years	37	33%

**Table 1:** Practice and educational background of tested subjects.

### Statistical analysis

Descriptive statistics were used to summarize participants' level of training, years of practice, proportion of correct responses and confidence level. Correlation coefficients were used to examine the relationship between confidence level and the survey score for each of the five case scenarios, as well as the total score obtained. Chi-square analyses were used to test comparisons between family and emergency room physicians on proportion of correct responses. In all tests, an alpha level of 0.05 or less was considered significant.

### Results

The results for the cases of interest are summarized in table 2. For the cases of interest, or subtle lfis, 65% of pcps correctly identified the presence and location of fractures. A misdiagnosis of "soft tissue sprain" was made 35% of the time. 56% of pcps were able to appreciate the unstable nature of the lfis presented. When a subtle lfi was present, only 17% of respondents were able to correctly identify the unstable nature of the injury. When considering both cases of interest, 54% of responding physicians indicated follow-up with an orthopaedic surgeon within the recommended two weeks. 34% of pcps indicated that either no follow-up was required within one month, or at all, following the injury. The remainder indicated that patient initiated follow-up with the family physician within two weeks was the preferred follow-up practice.

Question Type	Specific addressed questions	Topic by	% of participants answered correctly (Case 1)	% of participants answered correctly (Case 2)
Diagnosis	Fracture location		31%	79%
	Diagnosis of injury		61%	63%
	Stability		26%	26%
Management	Follow-up arrangements		69%	30%

**Table 2:** Summary of results from two subtle LFI case questions.

When assessing the responses on the three lisfranc scenarios, there was a trend towards improved performance by the emergency room physicians as compared to the family physicians who did not routinely do emergency room shifts, with respect to diagnostic accuracy (81% vs. 58% respectively,  $p=0.07$ ) similarly, relative to family physicians, emergency room physicians showed trends (though not statistically significant) toward improved performance in recognizing the location of the injury (70% vs. 50%;  $p=0.01$ ) and in managing the injury in a timely manner (73% vs. 46%;  $p=0.001$ ).

When examining the level of confidence of the physicians in diagnosing these injuries, family physicians were less confident than their emergency room colleagues. 29% of family physicians indicated that they were admittedly "unsure of myself" while only 8% of emergency room doctors were similarly unsure. Similarly, 68% of emergency room physicians indicated they were confident in their ability to diagnose and manage the injury while only 56% of family physicians were similarly confident. As a group, when correlating the confidence level of the pcp in interpreting and managing the clinical scenario to the number of correct responses for each case scenario, weak to moderate negative correlations were found (-.07 to -.53).

### Discussion

This study aimed, to assess the overall trends in knowledge and understanding of lfi amongst pcps in Ontario. The results from this study clearly demonstrated a gap in the knowledge and understanding of pcps in southeastern Ontario. This is supported by the overall trends in diagnostic accuracy, and in the management plans selected by the participating pcps. This conclusion is strongly supported by the high misdiagnosis rates of soft-tissue sprains (35%) and in the low percentage (54%) of pcps who selected appropriate followup by an orthopaedic surgeon in two very subtle but clear subtle lfis.

The challenges of recognizing the significant nature of this injury, despite its sometimes deceptively innocuous mechanism, have been theorized in the literature and were practically demonstrated by this study [1,3] despite the fact that pcps felt comfortable diagnosing and managing this injury, they were inaccurate in both making the diagnosis and then managing the subsequent injury. There are several possible explanations for this result. It may be due to a lack of training due to the low amount of musculo-skeletal (especially foot) content in the medical school and residency curriculum. Secondly, there may be a lack of clinical suspicion, which in the case of lfi is likely related to the lack of understanding of the injury and its mechanism. This inability of the pcps to relate the mechanism to the potentially significant injury leaves a potentially exploitable educational opportunity.

Much research has gone into establishing which imaging modality can most effectively diagnose, [6-8] and which treatment can optimize outcomes in the setting of lfis [1]. Unfortunately little research has looked into the circumstances surrounding the initial diagnosis of this injury. Similarly the authors were not able to find any substantial research that investigated the role that pcps and their understanding of lfis play in the diagnosis of this injury. Despite this, it is entirely plausible, and certainly suggested by the presented study that pcps can and do play a critical role in the initial recognition and management of this injury. This study highlights a potentially high-yield educational opportunity for foot and ankle surgeons. It would stand to reason, that an improved understanding of the injury and its appropriate treatment by pcps could effect a very substantial improvement in diagnosis rates, and therefore overall outcomes that are a result of this very time-sensitive injury.

Foot and ankle surgeons have several roles to play within the community that they work and live in. The role of the orthopaedic foot and ankle surgeon as a collaborator and as a source of musculoskeletal knowledge for the practitioners that he/she works with is rarely addressed with clinical research i.e., however, a relationship and a responsibility that has tremendous potential for improved musculoskeletal care. An orthopaedic foot and ankle surgeon that appropriately asserts him or herself as an educator could provide significant benefit to the pcps managing this injury as well as the patients that are affected by this potentially devastating injury, with relatively small associated costs to the health care system as a whole.

There were some definable weaknesses to our study. The response rate for this study was low at 22%, with only 13.4% being statistically useful. There was, however, reason to believe that the population who responded to our survey was representative of the actively practicing population; although some potential biases did exist. This is difficult to quantify, however. The Ontario medical association (or oma) published in 2007 basic data defining the demographics of their pcp membership based on only 554 respondents. (Representing roughly 6% of the 9719 active members of the Canadian college of family physicians currently registered in Ontario). The demographics of the studied physicians however seem reasonable. While oma records indicate that 93% of their pcp members have a predominantly office based practice, 79% of the family physicians in this study were primarily based in an office type practice, although there was a slightly higher response rates from for younger, more urban, less experienced physicians. The majority (or 51%) of surveyed physicians had greater than or equal to 10 years of experience as a practicing family physician. This compared reasonably to the oma pcps, which had an average age of 51. There was a disproportionate number of ccfp certified family physicians as well as a higher-than-average proportion of royal college of physician and surgeon (or frcsc) certified emergency room physicians in the studied cohort. It is, however, unclear as to how having younger, more urban family physicians could have skewed the results of our study.

An important question that arises from this study is whether computer-based questionnaires of this sort are able to precisely portray "real-life" clinical scenarios. Most medical training bodies in North America have adopted this technique in assessing competency in one form or another. This shift in medical education has been based on some research to this end; [10] however, it is unclear as to how accurate is a clinician's ability to make correct treatment decisions based on computerized case scenarios. Given these weaknesses, it is the intent of the authors in establishing and demonstrating gross

trends in levels of understanding, and basic practice principles. Statistical interpretations and any percentage differences, especially when considering group comparisons, should be rightly interpreted with caution.

The major strength of this study is that, to our knowledge, it is the first study to specifically address the clinical circumstances surrounding misdiagnosis of this potentially significant diagnosis. Prior to this study, the majority of the previous research focuses on accuracy of various imaging modalities and operative intervention, while the crux of the clinical problem (pcps recognizing the subtle nature of this injury's presentation, as well as the gravity of the diagnosis) was left unstudied. This study has also generated a validated survey for the assessment of knowledge and clinical understanding of lfis.

This study demonstrates a gap in understanding of lfis. Further research in this area is, therefore, warranted. As the presented survey is now validated for the study of lfi, it is possible to use this survey as a means of testing and validating educational initiatives aimed at increasing pcp's understanding of lfi and mid-foot trauma. Such research is currently underway at our institution.

## Conclusions

A directed educational intervention, ideally initiated by orthopaedic foot and ankle surgeons, aimed at teaching pcps the principles for diagnosis and management of lfis is likely indicated. Such an intervention may potentially help in increasing understanding and increasing the level of clinical suspicion when presented with the clinical scenario that can be associated with lfis. This may help in lowering the missed-diagnoses rate for lfis in Canadian emergency rooms and family practice offices.

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## References

1. Watson TS, Shurnas PS, Denker J (2010) Treatment of Lisfranc joint injury: current concepts. *J Am Acad Orthop Surg* 18: 718-728.
2. Kelikian (2011). Sarrafian's anatomy of the foot and ankle. Descriptive, topographic, functional, (3rd edn) kluwer/lippincott Williams & Wilkins, Philadelphia, USA: Wolters.
3. DeOrio M, Erickson M, Usuelli FG, Easley M (2009) Lisfranc injuries in sport. *Foot Ankle Clin* 14: 169-186.
4. Philbin T, Rosenberg G, Sferra JJ (2003) Complications of missed or untreated Lisfranc injuries. *Foot Ankle Clin* 8: 61-71.
5. Calder JD, Whitehouse SL, Saxby TS (2004) Results of isolated Lisfranc injuries and the effect of compensation claims. *J Bone Joint Surg Br* 86: 527-530.
6. Gupta RT, Wadhwa RP, Learch TJ, Herwick SM (2008) Lisfranc injury: imaging findings for this important but often-missed diagnosis. *Curr Probl Diagn Radiol* 37: 115-126.

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7. Hatem SF (2008) Imaging of lisfranc injury and midfoot sprain. *Radiol Clin North Am* 46: 1045-1060, vi.
  8. Preidler KW, Wang YC, Brossmann J, Trudell D, Daenen B, et al. (1996) Tarsometatarsal joint: anatomic details on MR images. *Radiology* 199: 733-736.
  9. Rammelt S, Schneiders W, Schikore H, Holch M, Heineck J, et al. (2008) Primary open reduction and fixation compared with delayed corrective arthrodesis in the treatment of tarsometatarsal (Lisfranc) fracture dislocation. *J Bone Joint Surg Br* 90: 1499-1506.
  10. Oliven A, Nave R, Gilad D, Barch A (2011) Implementation of a web-based interactive virtual patient case simulation as a training and assessment tool for medical students. *Stud Health Technol Inform* 169: 233-237.