

# The Lateral Hallux Stress Dorsiflexion View for Evaluation of Hallux Rigidus: A Prospective Assessment of Diagnostic Accuracy and Intermediate Term Outcomes with Cheilectomy

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## STATEMENT OF PURPOSE

- Preoperative staging for hallux rigidus (HR) is largely based on clinical and radiographic assessment aimed at predicting the condition of the joint surface.
- Early cartilage loss commonly occurs at the dorsal 1/3 of the 1<sup>st</sup> metatarsal head with progressive loss from dorsal to plantar as the disease moves to later stages (**Figure 1**).
- The hallux lateral stress dorsiflexion (LAT SD) view images the 1<sup>st</sup> MTPJ in a functional position of maximum DF allowing for radiographic assessment of the cartilage condition at the upper 1/3 of the joint (**Figure 2**).
- The purpose of this prospective study is to compare the LAT SD view to gold standard WB views in regards to accuracy of predicting cartilage condition, staging of HR and procedure selection, when compared to intra-operative findings and procedure performed.

## LITERATURE REVIEW

- Boffeli & Collier in 2015 concluded that the LAT SD view allows for the assessment of the upper 1/3 of the joint surface where cartilage damage is commonly seen in early disease [1].
- Taranto in 2005 concluded that the LAT SD view had low differences between raters and that the LSDA could be measured reliably [2].
- In 2002, Roukis et al. found a relationship between a novel radiographic grading system and the amount of cartilage loss found intraoperatively [3].

## METHODOLOGY

- We prospectively analyzed consecutive patients undergoing surgery for stage 2 and stage 3 HR.
- Inclusion criteria: over the age of 18 years, stage 2 or stage 3 HR, undergoing surgery.
- Exclusion criteria: under the age of 18 years, stage 1 or stage 4 HR, undergoing revision surgery, rheumatoid arthritis, or history of trauma to the 1<sup>st</sup> MTPJ.

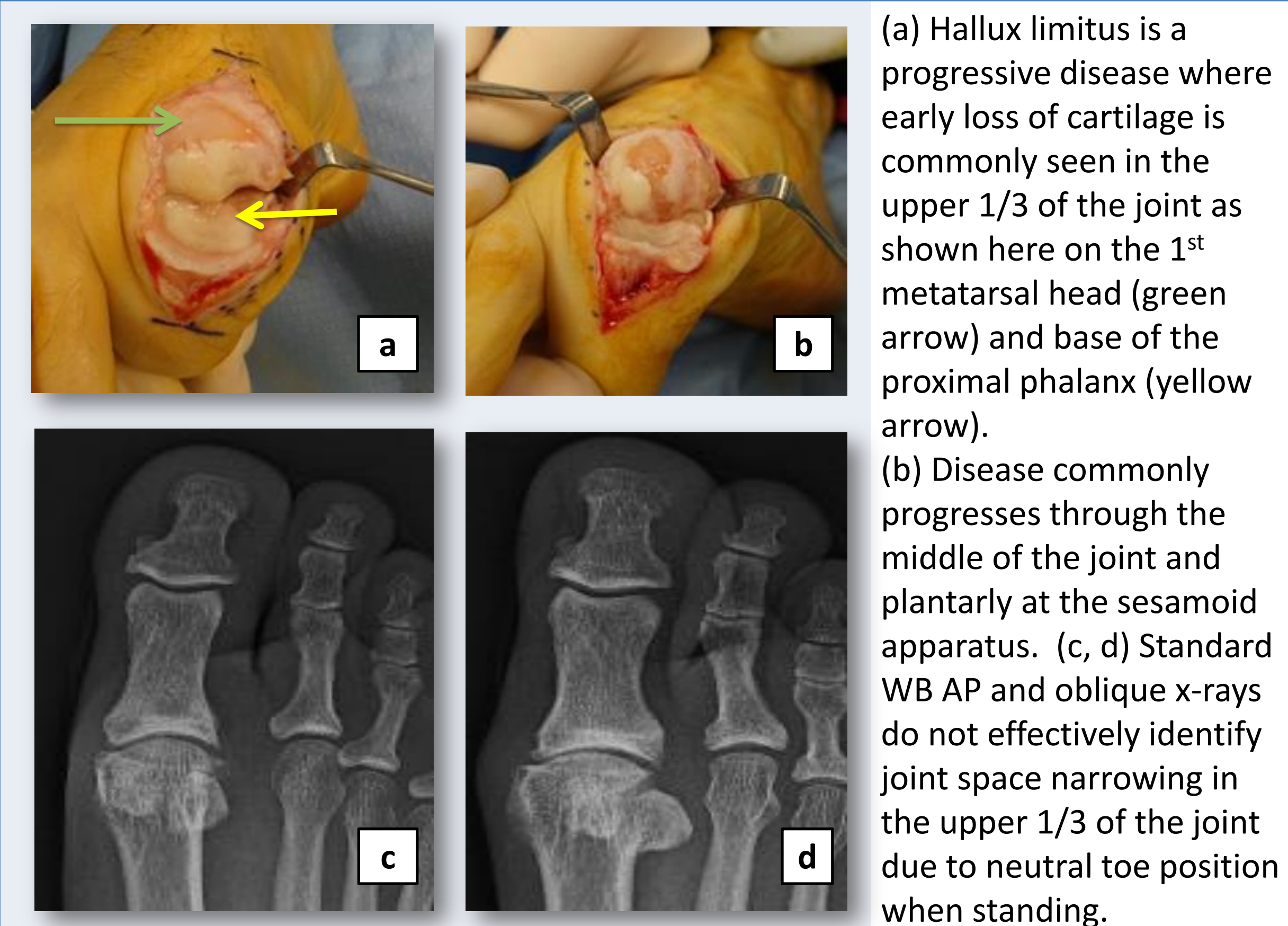
## Outcomes of Interest

- Patient characteristics including gender, age, BMI, laterality, cartilage condition, stage of HR, and complications were recorded.
- The cartilage condition and stage of HR was predicted prior to and after viewing the LAT SD view, and was confirmed intraoperatively.
- The LAT SD angle (LSDA) was measured preoperatively, at 6-10 weeks, and 1 year postoperatively.
- ACFAS and VAS scores were compared preoperatively and at 1 year postoperative.

## Statistical Analysis

- Continuous variables were described in terms of the mean  $\pm$  standard deviation (SD), range (minimum - maximum).
- Tests of the null hypothesis were used comparing the preoperative to postoperative outcomes, and statistical significance was set at P  $\leq$  0.5.

**Figure 1. Imaging challenges to assess upper 1/3 of joint**



(a) Hallux limitus is a progressive disease where early loss of cartilage is commonly seen in the upper 1/3 of the joint as shown here on the 1<sup>st</sup> metatarsal head (green arrow) and base of the proximal phalanx (yellow arrow).  
(b) Disease commonly progresses through the middle of the joint and plantar at the sesamoid apparatus. (c, d) Standard WB AP and oblique x-rays do not effectively identify joint space narrowing in the upper 1/3 of the joint due to neutral toe position when standing.

**Figure 2. Standard lateral view vs. LAT SD view in HR**



(a) Standard lateral WB view demonstrates dorsal spurs and intact joint space. (b) The same patient imaged with LAT SD view which allows radiographic evaluation of the first MTPJ in a functional position of maximum DF. Note joint space narrowing at the upper 1/3 of the joint which would predict full thickness loss of cartilage in this area. Bone-on-bone impingement on end range of DF is also evident which helps patients better understand why the joint hurts and what role the spurs play in their condition. Maximum DF can also be objectively measured and compared postoperatively.

**Table 1. Patient characteristics**

Variable	Average $\pm$ SD	Range (min - max)
Age (Years)	51.7 $\pm$ 12.3	21 to 64
BMI (kg/m <sup>2</sup> )	27.9 $\pm$ 5.0	20 to 37

**Table 2. Summary of results**

Gender	Total	Percentage
Males	8/18	44.4%
Females	10/18	55.6%
Side of Involvement		
Right	14/18	77.8%
Left	4/18	22.2%
Procedure		
Cheilectomy	11/18	61.1%
1 <sup>st</sup> MPJ fusion	3/18	16.7%
Midfoot fusion & cheilectomy	4/18	22.2%
Stage of HL/HR (based on intraoperative findings)		
Stage 2	8/18	44.4%
Early Stage 3	6/18	33.3%
Late Stage 3	4/18	22.2%

**Table 3. Comparison of preoperative estimation of cartilage condition & staging in HR to intraoperative findings**

Variable	Intra-op findings correlated w/ estimate PRE-LAT SD view	Intra-op findings correlated w/ estimate POST-LAT SD view	p value
Cartilage condition	5/18 (27.8%)	13/18 (72.2%)	<b>0.007</b>
Stage of HR	7/18 (38.9%)	11/18 (61.1%)	0.193

**Table 4. Comparison of preoperative to 1 year postoperative Lateral Stress Dorsiflexion Angle (LSDA)**

Variable	Average	Range (min - max)	p value
LSDA Preoperative	41.3°	30° to 65°	
LSDA 1 Year Postoperative	49.8°	35° to 68°	
Difference/improvement	9.4°	1° to 24°	0.055

**Figure 3. Demonstration of preoperative vs. postoperative lateral stress dorsiflexion angle (LSDA) on LAT SD imaging**



(a) LSDA is shown here on preoperative LAT SD view measuring 52 degrees which is compared to (b) postoperative LAT SD view measuring 69 degrees. Note 17 degrees improved DF ROM 6 weeks after cheilectomy.

**Table 5. Comparison of preoperative to 1 year postoperative ACFAS scores**

Variable	Average	Range (min - max)	p value
ACFAS Score Preoperative	48.6	23 to 63	
ACFAS Score 1 Year Postoperative	73.8	52 to 83	
Difference/improvement	25.2		<b>0.001</b>

**Table 6. Comparison of preoperative to 1 year postoperative VAS Scores**

Variable	Average	Range (min - max)	p value
VAS Score Preoperative	7.4	1 to 10	
VAS Score 1 Year Postoperative	1.5	0 to 7	
Difference	5.9		<b>0.001</b>

## RESULTS

- Patient characteristics are detailed in **Table 1** and **Table 2**.
- Correlation of predicted cartilage condition and staging of HR with confirmed intraoperative findings are depicted in **Table 3**.
- A comparison of the preoperative to 6-10 weeks, and 1 year postoperative LSDA is depicted in **Table 4**. The average improvement in the preoperative to 1 year postoperative LSDA was 9.4 (1 to 24) degrees (p = 0.055) (**Figure 3**).
- Preoperative to 1 year postoperative ACFAS scores and VAS scores are depicted in **Table 5**.
- All patients reported they would recommend to a friend, and 90% of patient's said they were very satisfied. No complications were identified at 1 year postoperative.

## ANALYSIS AND DISCUSSION

- This prospective study was performed to determine if obtaining a LAT SD view preoperatively along with standard radiographic views better correlates with intraoperative findings in HR.
- The results presented here show only 5/18 (27.8%) correlating with intraoperative findings with standard x-rays compared to 13/18 (72.2%) correlation with the LAT SD view (p = 0.007).
- A false negative, in the form of a central stellate lesion was noted in 5/18 (27.8%) of patients. This accounted for 100% of the patients whose LAT SD view did not correlate with intraoperative findings.
- The results found in this study showed a 7/18 (38.9%) staging correlation with standard x-rays compared to an 11/18 (61.1%) correlation with the LAT SD view, which allowed for a 22.2% rate of more accurate staging.
- LSDA allows objective preoperative assessment of maximum DF which can be compared to postoperative values. The average improvement in LSDA was 5.05 degrees at 6-10 weeks postoperative, and 9.4 degrees at 1 year postoperative (**Table 4**).
- ACFAS score had an average improvement of 31.4 (p = 0.001) and VAS pain scores improved an average of 5.9 (p = 0.001).

- Limitations include the relatively small group and intermediate-term follow up.
- The addition of the LAT SD view to the standard radiographic views allows for evaluation of the 1<sup>st</sup> MTPJ in a functional position of maximum DF allowing more accurate prediction of cartilage condition at the upper 1/3 of the joint minimizing unexpected intraoperative findings.

## REFERENCES

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