

# PREOPERATIVE RADIOGRAPHIC EVALUATION IN HAV SURGERY: A Critical Analysis of PASA and Other Soft Tissue Adaptations

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A thorough radiographic exam is an integral part of the preoperative evaluation for hallux valgus surgery. As the understanding of the hallux valgus deformity has evolved, a multitude of radiographic structural and positional relationships have been described. A majority of these relationships have significant correlation to clinical findings, and lend invaluable information in determining the choice of surgical procedures. However, several relationships have been described that do not consistently correlate with clinical and intraoperative findings, most notably, the Proximal Articular Set Angle (PASA) of the first metatarsal head. (Figure 1)

The actual clinical significance of the Proximal Articular Set Angle has been a subject of controversy throughout the podiatric community and essentially neglected in the orthopedic community. The author believes that the preoperative PASA has a very poor clinical correlation and is rarely seen intraoperatively. This opinion is in direct contrast to many podiatric surgeons as evidenced by Wooster et al.<sup>1</sup> In his review of recurrent hallux valgus deformities, Wooster found that a failure to correct PASA was the primary cause of recurrence. This controversy is further clouded by the well-documented poor reliability and reproducibility of preoperative radiographic measurements of PASA.<sup>2-4</sup>



**Figure 1.** Proximal Articular Set Angle - The angle formed by a line representing the effective articular cartilage and a line drawn perpendicular to the first metatarsal bisection.

In an effort to clarify some of the discrepancies regarding PASA measurements as a useful preoperative guide, an intraoperative analysis was undertaken by the author. In this analysis, the articular cartilage was examined on twenty hallux valgus patients after complete lateral and medial release. Intraoperative PASA measurements were made using metallic markers. These measurements were then compared to the corresponding preoperative proximal articular set angles.

In addition to evaluating PASA, the effects of lateral soft tissue contractures on the inter-

metatarsal angle were also examined. This concept was explored, based on the speculation that a significant amount of preoperative hallux abductus and sesamoid displacement may cause medial buckling of the first metatarsal, and contribute to the elevation of the intermetatarsal angle. Depending on the significance of these soft tissue contractures, the choice of structural procedures may change, once a complete lateral release has been performed.

### STUDY DESIGN

A series of 20 patients undergoing hallux valgus surgery were chosen on a random basis for intraoperative evaluation. The patient's age ranged from 28 to 67 years of age, with the average age being 40. Initial preoperative intermetatarsal angles ranged from 9° to 22°, with the average measurement being 14.35°. The 20 patients represent a diverse selection of patient type, age, and degree of deformity. (Table 1, Column A)

**Table 1**  
**EFFECT OF SOFT TISSUE RELEASE**  
**ON IM ANGLES**

Patient	Age	COLUMN A	COLUMN B
		Preop IM Angle	IM Post-Release
#1	41	12	12
#2	56	10	12
#3	51	18	19
#4	62	13	11
#5	63	18	22
#6	28	10	9
#7	61	18	18
#8	36	9	11
#9	40	12	10
#10	43	10	6
#11	58	9	10
#12	43	12	10
#13	26	13	15
#14	60	12	10
#15	62	19	16
#16	58	20	15
#17	31	14	15
#18	66	23	21
#19	58	16	14
#20	67	19	16

Twenty randomly chosen patients with hallux abducto valgus including patient's age, preoperative IM angle (A) and intraoperative IM angle after complete medial and lateral soft tissue release (B).

### Proximal Articular Set Angle

The preoperative and intraoperative D-P radiographs were used to calculate the proximal articular set angle. Traditional measurement techniques were applied. (Figure 1) Both sets of measurements were taken postoperatively so as to avoid any bias when performing the intraoperative evaluation. Measurements were taken by the author and an impartial podiatric physician.

The preoperative radiograph was a standard dorsal-plantar projection with the subtalar joint held in neutral position and midtarsal joint maximally loaded while the patient was lying on the operating table. The intraoperative view was taken after a complete lateral release and first metatarsophalangeal joint arthrotomy were performed. These maneuvers allowed complete visualization of the articular cartilage on the first metatarsal head.

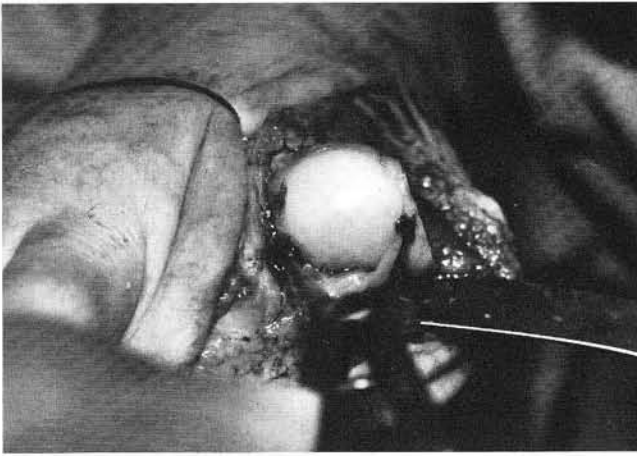
The most medial and lateral extent of the functional articular cartilage were identified and marked with a small drill hole. The arms of a stainless steel caliper were then inserted in the drill holes to prevent slippage as the x-ray was taken. (Figure 2A, 2B, 3) To allow for accurate reproduction of pre- and intraoperative views, a foot cradle was used to minimize hip and leg rotation.

### Intermetatarsal Angle

The same method of measurement used for PASA was also used to evaluate the effects of lateral soft tissue contractures on the intermetatarsal angle. The previous preoperative x-ray used for PASA assessment was also used in this measurement. In



**Figure 2A.** Following complete lateral and medial release, the articular cartilage is easily identified.



**Figure 2B.** Metallic caliper identifying the extent of articular cartilage on the metatarsal head.



**Figure 3.** Intraoperative x-ray with metallic caliper in place, revealing the direction of the articular cartilage and its relationship to the metatarsal shaft.

addition, because the intraoperative radiograph used in the PASA calculation was taken after complete lateral release and MPJ arthrotomy, this same view could be used to assess any change that occurred in the intermetatarsal angle.

## RESULTS

The preoperative and intraoperative PASA measurements of twenty patients were compared. (Table 2) The preoperative and intraoperative IM angles were then compared after complete lateral and medial release.

Although no actual statistical analysis was performed, several obvious conclusions can be drawn from this study. The diverse patient population in this study demonstrated only three cases of theoretical structural adaptation of the articular cartilage. Although these three patients had proxi-

**Table 2**

### RADIOGRAPHIC VS. SURGICAL EVALUATION OF PASA

Patient	Preop PASA	Intraop PASA
#1	8	8
#2	12	8
#3	12	5
#4	18	4
#5	20	8
#6	10	6
#7	14	8
#8	6	6
#9	6	0
#10	15	14
#11	17	5
#12	10	6
#13	22	8
#14	11	6
#15	21	20
#16	28	10
#17	21	8
#18	14	7
#19	15	6
#20	16	7

Preoperative radiographic measurement of PASA, compared with intraoperative measurement of PASA using a metallic caliper to identify the medial and lateral extent of the articular cartilage.

mal articular set angles above the normal range ( $7.5^{\circ}$  to  $8^{\circ}$ ), correlation to the preoperative measurement and clinical significance was extremely poor. No attempt was made to address PASA during the surgical reconstruction in any of these patients. Despite this lack of correction, follow-up x-rays in this group fail to demonstrate residual pathology at the level of the articular cartilage. In addition to the above findings, the reliability and

reproducibility of the measurement itself is suspect. Both intra- and inter-evaluator inconsistencies are well documented in the literature.

Articular cartilage adaptation is, however, occasionally seen in recurrent hallux valgus deformities, especially where rotational-type procedures have been used (base wedge, Mau, crescentic). The author has noted this deformity intraoperatively in several patients. PASA in these patients is attributed more to the mechanics of the original procedure as opposed to secondary adaptation.

The second part of this study assessed the assumption that retrograde buckling (lateral soft tissue contracture with hallux abductus) contributes to the intermetatarsal angle measurement. If this soft tissue contribution was significant, then the choice of osteotomies may change following lateral release.

The design of the primary study (evaluating PASA) allowed the author to examine the intermetatarsal angle both before and after lateral release. The results, however, did not confirm the preoperative suspicion. (Table 1, Column B) There were as many patients that had an increased IM angle after release as there were with a decreased IM angle. The reason for this

finding is difficult to ascertain. More extensive studies are warranted prior to drawing any definitive conclusions on this subject.

## SUMMARY

Although rudimentary in design, the study raises suspicions about the usefulness of measuring the preoperative proximal articular set angle in hallux valgus deformities. More importantly, the actual existence of a true structural adaptation of the metatarsal head and its clinical relevance must be critically analyzed. If this deformity is present, it can be accurately identified only in the intraoperative period as the articular cartilage is visualized.

## REFERENCES

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