SURGICAL MANAGEMENT OF HALLUX ABDUCTO VALGUS WITH CONCOMITANT METATARSUS ADDUCTUS

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The surgical management of hallux abducto valgus (HAV) in patients with metatarsus adductus deformity is a particular challenge to the podiatric surgeon. Determination of the most appropriate surgical procedure(s) will depend upon the degree of symptomatology, age of the patient, severity of both HAV deformity and the metatarsus adductus deformity. The adult patient must be approached in a different manner than the pediatric patient.

In dealing with the pediatric bunion deformity, every effort must be made to identify the presence or absence of underlying metatarsus adductus. Our experience has shown that this is a relatively common entity. A comprehensive examination should be performed to determine the degree of compensation occurring in the rearfoot complex when metatarsus adductus is present. In the juvenile with significant hallux abducto valgus deformity and significant metatarsus adductus, correction of both components may be necessary. In general, this will consist of osteotomies of the first through fifth metatasals with either a transverse or oblique closing base wedge osteotomy of the first metatarsal segment. By restoring structural alignment to the forefoot on the midfoot at the level of LisFranc's joint, abduction of the hallux and lesser digits will be decreased.

Correction allows a more direct line of pull of both the intrinsic and extrinsic musculature which govern the function and position of each of the metatarsophalangeal joints (MPJs). The improved alignment of the flexor hallucis longus (FHL) and the intrinsic musculature of the first metatarsophalangeal joint decreases the likelihood of recurrence of deformity.

In certain cases, even following successful correction of the hallux abducto valgus deformity, metatarsus primus adductus deformity, and metatarsus adductus deformity, additional surgical procedures may be required to correct pes valgo planus and equinus. In an occasional case involving concomitant pes valgo planus deformity, the rearfoot deformity may become exaggerated following correction of only the forefoot.

The procedures we most commonly employ for correction of pes valgo planus deformity include the Evans calcaneal osteotomy, alone or in combination with medial arch tendosuspension, and a gastrocnemius resession or tendo Achillis lengthening. Following structural realignment of the foot, appropriate biomechanical control should be instituted.

The juvenile or adolescent bunion deformity with only mild to moderate metatarsus adductus which is asymptomatic and has only mild to moderate compensation in the rearfoot may be satisfactorily corrected without addressing the metatarsus adductus deformity. In such cases, aggressive surgical treatment of the hallux abducto valgus and metatarsus primus varus (MPV) is recommended to minimize the possibility of recurrence of deformity.

It is recommended that the more proximally based osteotomies of the first metatarsal be used for correction of metatarsus primus adductus in such patients. In radiographic evaluation of such feet, the intermetatarsal angle must be considered to be significantly greater than that determined by actual measurement. It is not uncommon to strive to obtain a reduction of the intermetatarsal angle intraoperatively, to 0 to -two or -three degrees. In some cases, an opening wedge osteotomy of the first metatarsal or medial cuneiform may be an appropriate procedure. If severe obliquity of the metatarsocuneiform joint is present on the dorsoplantar (DP) x-ray, an opening wedge osteotomy with insertion of an allogeneic or autogenous corticocancellous graft is used. This is combined with a base wedge osteotomy of the first metatarsal.

Clinical experience shows that even when the intermetatarsal angle has been reduced to a slightly negative value, an increased separation between the first and second metatarsals will be seen later when full weight-bearing function has been restored to the foot. This ultimately results in a final intermetatarsal angle of approximately 0 to five degrees.

When dealing with a pediatric patient, particular caution is necessary in operating around the growth plate. If an open physeal plate is present, care must be taken to ensure that damage does not occur intraoperatively. The growth plate should be identified and visualized at

the time of surgery and the osteotomy executed just distal to it, but as close as possible to it, in order to obtain the full effect of the mechanical principles of the radius arm concept. This allows the most effective mechanical reduction of the intermetatarsal angle. Soft tissue muscle tendon balance and a McBride bunionectomy are performed at the level of the metatarsophalangeal joint. The critical aspects of the procedure here include mobilization and relocation of the sesamoid apparatus beneath the first metatarsal head. This restores the proper anatomic position of the intrinsic and extrinsic musculature.

The adductor tendon transfer is particularly helpful in accomplishing this goal. When the sesamoid apparatus is not centralized beneath the first metatarsal head, the lateral intrinsic musculature and eventually the flexor hallucis longus tendon cause a recurrence of the deformity in the ensuing years. The displaced tendons gain mechanical advantage over the more medial tendinous structures.

In patients with a significant adaptation of the distal cartilage of the first metatarsal, a Reverdin type osteotomy may be required, along with a proximal metaphyseal base osteotomy. Akin type osteotomies are rarely used and should be used with caution, reserving them only for those cases where significant hallux abductus interphalangeus is identified. The indiscriminate use of the Akin procedure to straighten the great toe is likely to result in greater pathology if the other structural abnormalities have not been precisely and completely corrected. This is particularly true in individuals with symptomatic metatarsus adductus deformity.

Although the Akin procedure may contribute greatly to restoring a straight medial border of the foot, it results in an obvious separation between the hallux and lesser digits which are already abducted relative to their adjacent metatarsals. This is part of the normal metatarsus adductus foot type. The result is physical incompatibility with normal shoes. In order for the medial border of the foot to conform to the shoe, the great toe must deviate laterally, resulting in loss of joint congruity at the first metatarsophalangeal joint. In addition, the large separation between the hallux and the second digit is unsightly if not grotesque.

The goal of surgery should be to reduce the intermetatarsal angle and bring the first metatarsal in as close proximity to the second metatarsal as possible. It should not be to pull the hallux around the distal end of the first metatarsal.

Clinical experience has shown that patients who undergo surgical correction of a hallux abducto valgus deformity in the presence of a structural metatarsus adductus frequently have a residual bunion deformity, or clinical hallux abducto valgus deformity, without any radiographic evidence of such. In many cases, the surgeon may identify full correction and normalcy of most radiographic parameters. The degree to which the clinical appearance of a residual bunion and hallux abducto valgus deformity occurs is proportional to the degree of metatarsus adductus deformity and the degree of compensation present. The greater the metatarsus adductus deformity, the greater the abduction of the hallux and lesser digits on their adjacent metatarsal. Ultimately translated, this manifests itself as a residual bunion and hallux abducto valgus deformity.

The hallux and digits generally remain parallel to the long axis of the calcaneus regardless of the degree of metatarsus adductus deformity present. Certainly, there are some exceptions to this rule. However, the amount of abduction present between the digit and its adjacent metatarsal will generally increase as the degree of metatarsus adductus increases. This will be accentuated by pronation of the subtalar joint and midtarsal joints as compensation for the metatarsus adductus deformity. There is a temptation to decrease this residual bunion appearance by excessive resection of the medial eminence (i.e., staking). This should be avoided at all costs, for it does not decrease the clinical residual bunion appearance.

Distal metaphyseal osteotomies, of which the Austin bunionectomy and its modifications are most popular, are reserved for those patients with only mild to moderate hallux abducto valgus deformity and mild metatarsus adductus. One should remember that distal metaphyseal osteotomies do not provide true structural correction of the metatarsus primus varus, but rather a relative reduction of the intermetatarsal angle only. Our staff has not found distal type osteotomies to be highly successful in those patients with significant underlying metatarsus adductus deformity. We continue to prefer the more proximally based metaphyseal wedge osteotomies with or without simultaneous correction of the metatarsus adductus component.

Surgical management of hallux abducto valgus deformity in the adult with significant metatarsus adductus deformity is an extremely challenging clinical entity. In general, we recommend avoiding correction of the metatarsus adductus in the adult with such a deformity unless major and significant clinical disability and symptomatology are present. This may be present in extreme

cases of compensation in which the foot is in a severe pes valgo planus attitude or in cases where there is minimal compensation for the metatarsus adductus and the foot presents as a mild cavus deformity. The latter situation is less likely to present itself with a bunion deformity.

Major alterations of all the metatarsals on the adult foot may have significant adverse effects on the remaining structure and biomechanical function of the mature foot. We do, however, recommend an aggressive surgical approach to correction of the hallux abducto valgus deformity, even when only a mild or moderate increase in the intermetatarsal angle is identified. Commonly employed procedures include base wedge osteotomies of the first metatarsal and a modified McBride bunionectomy at the metatarsophalangeal joint level. Reverdin type osteotomies are preferred to correct significant deviations of the proximal articular cartilage (PASA).

Surgical procedures must necessarily emphasize reduction of the intermetatarsal angle first which, although radiographically moderate, is clinically very significant. We feel that it may be extremely risky to aggressively correct adult hallux abducto valgus deformity present with significant metatarsus adductus by distal metaphyseal osteotomies and extensive soft tissue procedures. Such attempts are met with disenchantment by the patient. This will be particularly true if significant digiti abductus is already present.

MATHEMATICAL INTERRELATIONSHIPS

The following is an attempt to mathematically explain the relationship and influence of metatarsus adductus on hallux abducto valgus and metatarsus primus adductus (varus). Emphasis will be placed on the surgical treatment implications. These new angular relationships should prove helpful in selecting the most appropriate procedures and in deciding whether correction of the metatarsus adductus is necessary to ensure adequate long-term correction of the hallux abducto valgus deformity. The clinical implications become self evident once the basic relationships are understood. The authors do not wish to imply that the proposed mathematical models explain all successes or failures of hallux abducto valgus correction in the face of metatarsus adductus, but rather help the practitioner understand the complex interrelationship which exists between the two entitites. Compensatory changes and influence of rearfoot compensation and pronation must also be given consideration.

The following traditional angular relationships and their normal values will serve as the basic foundation upon which we build these mathematical relationships and formulas:

Metatarsus adductus angle	0-15°
Cuboid abduction angle	0- 5°
Digiti abduction angle	0- 8° (15°)
Hallux abductus angle	0-15°

We have arbitrarily graded hallux abductus deformity as follows:

Normal	0-16°
Mild	17-25°
Moderate	26-34°
Severe	>35°

We have arbitrarily graded metatarsus adductus as follows:

Normal	0-15°
Mild	16-20°
Moderate	21-25°
Severe	>25°

The clinical implications and translation of these various parameters can be summarized as follows.

1. Cuboid abduction (indicating midfoot abduction on the rearfoot) in conjunction with digiti abduction effectively balance or negate any metatarsus adductus and are what accounts for the overall straight clinical appearance of the foot with metatarsus adductus.

2. As the degree of metatarsus adductus deformity increases, one generally sees an increased amount of digiti abduction in an attempt to maintain a parallel relationship between the hallux and digits and the long axis of the rearfoot (calcaneus). We commonly accept that: A) the hallux and lesser digits are parallel to each other, and B) the hallux and lesser digits are parallel to the rearfoot axis (calcaneus) in the normal foot.

3. As the degree of metatarsus adductus deformity increases, one may also see an increase in cuboid abduction as further compensation. In severe cases, one sees what has classically been referred to as serpentine, *Z*, or skewfoot deformity. The foot is clinically straight overall but severely pronated, often with total collapse of the medial longitudinal arch. The foot is usually *pancake* in appearance; wide overall in both the forefoot and rearfoot and lacking the usual appearance of a wider forefoot and

narrower rearfoot. The x-ray usually identifies the osseous malalignment. One should be aware that compensation does not always take place in the metatarsus adductus foot.

Though a metatarsus adductus can hide clinically, it cannot do so on radiographs. Radiographic evaluation clearly identifies both the metatarsus adductus deformity and its compensation. This mismatch, between the clinical and radiographic findings, has serious implications when surgically addressing hallux abducto valgus and metatarsus primus varus deformities and accounts for many of the failures that occur.

In clinical practice, we have all identified patients with a moderate to severe medial bunion deformity and significant hallux abductus, but with only a mild to moderate increase in the intermetatarsal angle. In such cases, the clinical presentation does not match the expected radiographic findings.

Determination of the ideal procedure(s) for correction of these deformities must be based upon an understanding of the complex relationship between metatarsus adductus, hallux abductus, and metatarsus primus adductus. It should not be based upon the simply measured intermetatarsal angle or hallux abductus angle on dorso plantar x-ray. Simply adding one or two degrees to the measured intermetatarsal angle rarely changes the surgeon's selection of procedure. However, the addition of seven or eight degrees to the measured angle, more often than not, would change the selection of procedure.

As the degree of metatarsus adductus deformity increases, we expect an increase in the amount of digiti abductus. Because the hallux attempts to maintain a parallel relationship with the lesser digits, we see a concomitant increase in hallux abductus. The intermetatarsal angle, however, appears to decrease as the metatarsus adductus deformity increases. This is often referred to as a piling-up effect at the bases of the metatarsals. This also gives an impression of a long first metatarsal. The functional or true intermetatarsal angle is, however, significantly greater than the measured intermetatarsal angle.

To summarize thus far:

> The greater the metatarsus adductus, the greater the hallux abductus and the smaller the intermetatarsal angle.

$$MAA \uparrow \quad HAA \uparrow \quad IMA \downarrow$$

Where:
MAA = metatarsus adductus angle
HAA = hallux abductus angle
IMA = intermetatarsal angle.

An alternative way to visualize this complex relationship is as follows: Digits constantly attempt to maintain their parallel relationship with longitudinal axis of the rearfoot. When metatarsus adductus is present, what we have is a significant medial deviation of a segment of the foot (metatarsals) on the long axis of the rearfoot. Cuboid abduction, if present, will help to negate the adverse clinical effects of the metatarsus adductus. Let us assume for a moment, however, that cuboid abduction is absent. In this case, the greater the degree of adduction of the lesser metatarsals, the greater the degree of adduction of the first metatarsal in relationship to the rearfoot axis, and thus, the greater amount of hallux abductus and digiti abductus. Where the digits and hallux do not abduct, the clinical manifestation would be hallux varus and digiti adductus with significant intoeing.

The converse of this is also true but implies that the smaller the adduction angle of the first metatarsal, the less the hallux abductus. We can now appreciate that reduction of the intermetatarsal angle alone, as based upon x-ray measurement may not ensure a good clinical result if moderate or severe metatarsus adductus is left uncorrected. For example, an individual with 50 degrees of metatarsus adductus (an exaggerated case, of course) and a 0 degree intermetatarsal angle would obviously have a severe hallux abducto valgus deformity as the hallux and lesser digits maintain their parallel relationship to the calcaneus (rearfoot axis). Neither a distal metaphyseal osteotomy, proximal metaphyseal osteotomy or any combination with soft tissue muscle tendon balance would adequately correct such a deformity. The metatarsals as a unit would require alteration so as to decrease both the metatarsus adductus angle and the intermetatarsal angle. It is not the hallux which is abnormally positioned, but rather the first metatarsal along with the lesser metatarsals.

FIRST METATARSAL REARFOOT ADDUCTION ANGLE

The authors strongly suggest that a more meaningful radiographic parameter would be the angular relationship of the first metatarsal to the rearfoot axis (longitudinal axis of the calcaneus). We refer to this as the first metatarsal rearfoot adduction angle ($MRAA_{1st}$). The difficulty with determining this angle on x-ray is the controversy over effectively identifying the long axis of the rearfoot. While in some patients this may be easy to do, in other patients it will be difficult. Mathematically, it can be defined as:

$$IMA + MAA - CAA = MRAA_{1st}$$

Where:
IMA = intermetatarsal angle
MAA = metatarsus adductus angle
CAA = cuboid abduction angle

If this number is excessive, one could predict that a significant hallux abducto valgus deformity is likely to be present. A high $MRAA_{1st}$ with a low IMA on x-ray would indicate a significant structural metatarsus adductus deformity. Clinically, this foot presents with a significant bunion and hallux abducto valgus deformity but without the normal anticipated radiographic findings of a large intermetatarsal angle.

The ranges and criteria have yet to be definitively determined. This will remain an area of continued clinical and radiographic study.

Because of the high degree of emphasis placed on the intermetatarsal angle we will attempt to mathematically explain the concept of arbitrarily adding one or two degrees to the measured intermetatarsal angle. We will further suggest a new and more accurate method to determine the true or effective intermetatarsal angle.

TRUE INTERMETATARSAL ANGLE DETERMINATION (IMA_t)

The true intermetatarsal angle can be defined mathematically by the formula:

$$IMA + (MAA - 15°) = IMA_t.$$

Where:
- IMA = intermetatarsal angle as measured on the DP x-ray
- MAA = metatarsus adductus angle as measured on the DP x-ray.

Example:
IMA = 8°; MAA = 25°; then:
$8 + (25° - 15°) = 18°$ (IMA_t).

This does not take into consideration cuboid abduction as compensation for the metatarsus adductus. In such cases, the formula would be altered to read:

$$IMA + (MAA - 15°) - CAA = IMA_t.$$

Where:
- IMA = intermetatarsal angle as measured on the DP x-ray
- MAA = metatarsus adductus angle as measured on DP x-ray
- CAA = cuboid abduction angle as determined on DP x-ray

POSTOPERATIVE HALLUX ABDUCTUS ANGLE ($HAA_{p°}$)

This can be defined mathematically by the formula:

$$MAA + IMA_{p°} = HAA_{p°}.$$

Where:
- MAA = metatarsus adductus angle as measured on DP x-ray
- $IMA_{p°}$ = intermetatarsal angle (between 1 and 2) as measured on DP x-ray, postoperatively.

Example:
MAA = 20°; $IMA_{p°}$ = 8°; then,
$20° + 8° = 28°$ ($HAA_{p°}$)

In spite of an 8 degree $IMA_{p°}$, there is still a moderate hallux abducto valgus deformity of 28 degrees due to the presence of an uncorrected underlying metatarsus adductus. This assumes that there is digiti abductus present as a result of the hallux and digits maintaining their parallel relationship to the rearfoot.

It is commonly accepted that true structural correction of the intermetatarsal angle requires the use of a base wedge osteotomy of the first metatarsal. Distal metaphyseal osteotomies result in an apparent reduction only. They should be used with caution and only in those cases with mild metatarsus adductus. The authors believe this to be most important when surgically correcting hallux abducto valgus deformity combined with metatarsus adductus.

We can illustrate the use of the above formulas considering three separate clinical situations in which varying degrees of metatarsus adductus remain uncorrected, and in which the hallux abducto valgus deformity is corrected by reduction of the intermetatarsal angle to either 8 degrees (a commonly accepted value of normal) or to 0 to -2 degrees. Using these parameters, we can predict (at least in theory) the degree of correction which will be seen postoperatively. These results are especially likely if the hallux drifts laterally to maintain a parallel relationship to the lesser digits, and the lesser digits maintain a parallel relationship to the rearfoot.

SITUATION 1

Uncorrected MILD Metatarsus Adductus (16-20°)
Corrected HAV deformity.

Scenario 1:		*Scenario 2:*	
$IMA_{p°}$	= 8°	$IMA_{p°}$	= 0 to -2°
MAA	= 18°	MAA	= 18°
$HAA_{p°}$	= 26°	$HAA_{p°}$	= 16-18°
(Moderate HAV)		(Mild HAV)	
(True IMA = 11°)		(True IMA = 1-3°)	

Commentary

In Scenario 1, while the radiographic IMA measures 8 degrees, the true IMA would equal 11 degrees. An 11

degree IMA itself would appear of little consequence; however, using the formula for determination of the postoperative HAA ($HAA_{p°}$), we can predict 26 degrees of HAV deformity. Clinically, this would appear as a moderate hallux abducto valgus deformity and may not be acceptable to either the surgeon or patient.

In Scenario 2, on the other hand, if aggressive correction were performed (i.e., base wedge osteotomy) to create on dorso plantar x-ray and IMA which measures 0 to -2 degrees, the true IMA would equal 1-3 degrees. In this scenario, the predicted postoperative HAA ($HAA_{p°}$) would be 16-18 degrees. Clinically, this would appear as a mild hallux abducto valgus deformity and would certainly be acceptable to both the physician and patient.

In Scenario 1, the $MRAA_{1st}$ would be 26 degrees. In Scenario 2, the $MRAA_{1st}$ would be 16-18 degrees.

SITUATION II

Uncorrected MODERATE Metatarsus Adductus (21-25°)
Corrected HAV deformity.

Scenario 1:		*Scenario 2:*	
$IMA_{p°}$	= 8°	$IMA_{p°}$	= 0 to -2°
MAA	= 24°	MAA	= 24°
$HAA_{p°}$	= 32°	$HAA_{p°}$	= 22-24°
(Moderate HAV)		(Mild HAV)	
(True IMA = 17°)		(True IMA = 7-9°)	

Commentary

In Scenario 1, while the radiographic IMA again measures only 8 degrees, the true IMA would equal 17 degrees. A 17 degree IMA would have potential undesirable consequences. The predicted postoperative HAA ($HAA_{p°}$) would be 32 degrees. Clinically, this would appear as a moderate HAV deformity and would probably not be acceptable to either the surgeon or the patient.

In Scenario 2, on the other hand, if aggressive correction were performed to create an IMA measuring 0 to -2 degrees, the true IMA would equal 7-9 degrees. This 7-9 degree value is commonly accepted as an excellent postoperative correction and actually serves as the current standard of care in HAV surgery. Furthermore, in this scenario, the predicted postoperative HAA ($HAA_{p°}$) would be 22-24 degrees. Clinically, this would appear only as a mild HAV deformity and would most probably be acceptable to both the surgeon and patient. The outcome here is quite similar to Scenario 2 of Situation I.

In Scenario 1, the $RMAA_{1st}$ would be 32 degrees. In Scenario 2, the $RMAA_{1st}$ would be 22-24 degrees.

SITUATION III

Uncorrected SEVERE Metatarsus Adductus (>25°)
Corrected HAV deformity.

Scenario 1:		*Scenario 2:*	
$IMA_{p°}$	= 8°	$IMA_{p°}$	= 0 to -2°
MAA	= 30°	MAA	= 30°
$HAA_{p°}$	= 38°	$HAA_{p°}$	= 28-30°
degrees (Severe HAV)		(Moderate HAV)	
(True IMA = 23°)		(True IMA = 13-15°)	

Commentary

In Scenario 1, while radiographic IMA again measures 8 degrees, the true IMA would equal 23 degrees. A 23 degree IMA would clearly have adverse consequences. The predicted postoperative HAA ($HAA_{p°}$) would be 38 degrees. Clinically, this would appear as a severe HAV deformity and would not be acceptable to either the surgeon or the patient.

In Scenario 2, even with reduction of the IMA on dorso plantar x-ray to 0 to -2 degrees, the true IMA would equal 13-15 degrees. A 13-15 degrees IMA would not be an acceptable result. Furthermore, in this scenario, the predicted postoperative HAA ($HAA_{p°}$) would be 28-30 degrees. Clinically, this would appear as a moderate HAV deformity and would more than likely be unacceptable to either the surgeon or the patient.

DISCUSSION

It should be clear from the foregoing discussion that HAV deformity, combined with significant structural metatarsus adductus, requires very special treatment considerations. Surgical correction must emphasize reduction of the intermetatarsal angle in most situations and simultaneous correction of the metatarsus adductus deformity in more severe circumstances. The implications for surgery can be summarized as follows:

1. Correction of HAV deformity alone is likely to be successful with mild metatarsus adductus.
2. Correction of HAV deformity alone is likely to result in a mild to moderate HAV deformity when moderate metatarsus adductus deformity is present and left uncorrected.
3. Correction of HAV deformity alone will most likely fail with severe metatarsus adductus deformity uncorrected.

The primary procedure for correction of an HAV deformity with metatarsus adductus is the closing base wedge osteotomy in conjunction with muscle tendon balance at the metatarsophalangeal joint. Distal metaphyseal osteotomies represent a distant second choice and should be limited to situations where a metatarsus adductus component is mild and possibly moderate. Caution should be exercised with the use of distal metaphyseal osteotomies designed to reduce the PASA and proximal phalangeal osteotomies (Akin type) which will provide a pseudo-correction that will be temporary at best. In the juvenile and adolescent patient with significant metatarsus adductus, correction should consist of osteotomies of all the metatarsals to restore normal alignment to the forefoot, thus allowing proper and stable correction of the HAV deformity.

Our preference in metatarsus adductus correction is for the Lepird procedure (oblique closing base wedge osteotomy of the first metatarsal and oblique rotational osteotomies of metatarsals two through five), a modified Berman-Gartland procedure. Correction of severe uncontrollable pronation resulting in pes valgo planus should also be considered. Primary procedures will consist of the Evans calcaneal osteotomy and medial arch reconstruction via a modified Young's tenosuspension and/or Kidner procedure. Equinus is corrected via a tendo Achillis lengthening or gastrocnemius recession.

SUMMARY

An attempt has been made to define the relationship that exists between metatarsus adductus, metatarsus primus adductus (varus), and hallux abducto valgus. Several mathematical formulas have been presented and represent five years of ongoing clinical and radiographic study. Clear cut guidelines and indications have yet to be established and remain a goal of the future.

Correction of hallux abducto valgus deformity in a patient with metatarsus adductus deformity is a challenging clinical exercise which requires a comprehensive clinical and radiographic evaluation to determine the most appropriate surgical procedures. Consideration must be given to the degree and severity of deformity and compensation present, presence or absence of clinical symptomatology, age of the patient, quality of bone, and finally, the expectations of the patient seeking correction of deformities.

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