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First Metatarsal Shaft Osteotomies: A Wide Range of  
Correction for Hallux Valgus Deformity

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#### Introduction

For correction of hallux valgus deformity, the only treatment is surgical correction. Considerations for technical choice include the hallux valgus angle, intermetatarsal angle, arthritis in the first metatarsophalangeal (MTP) joint, hypermobility of the first tarsometatarsal(TMT) joint, position of sesamoids, muscle-tendon balance and congruity of the first MTP joint. (1)Surgical techniques include soft tissue procedures, metatarsal and phalangeal osteotomies and combinations of them.

The main objective of metatarsal osteotomies is to decrease the intermetatarsal angle. Distal, shaft and proximal osteotomies have been defined based on the osteotomy site. Distal osteotomies mainly used for mild deformities and proximal osteotomies are suitable for severe deformities. Metatarsal shaft osteotomies may be used for all mild, moderate and severe cases.

Metatarsal shaft osteotomies have been recognized for more than nine decades. They became popular in recent decades after some modifications. Most commonly known shaft osteotomies are Ludloff, Mau and Scarf osteotomies. All these osteotomies have been thought as not being ideal and new modifications have been made. These modifications mainly focus on efforts to increase contact surface, improve union and osteotomy stability, decrease shortening, dorsal angulation and osteotomy related complications and to widen the indications. Offset V osteotomy- as a modification of distal Chevron osteotomy- and Baran-Unal osteotomy-as a modification of Mau osteotomy and Myerson modification of Ludloff osteotomy may be added to the basic shaft osteotomies as major modifications

(2,3,4,5). All modifications aim to decrease the main disadvantage of the classical osteotomies.

Metatarsal shaft osteotomies are more stable and have more contact area than distal and proximal metatarsal osteotomies. As so in this review. I investigate the metatarsal shaft osteotomies and their well known modifications from all views like correction capability, stability and complications.

#### Osteotomies

##### Ludloff Osteotomy

This osteotomy was described by Ludloff at 1918(1). It is a simple oblique osteotomy. It starts from dorsal proximal part of first metatarsal, goes as an oblique line and end at distal plantar part of the bone(6)(Figure-1).

At Myerson modification, osteotomy starts more proximally and ends more distally. So the osteotomy contact area is more at this modification(6). There are some other modifications to avoid complications and improve fixation strength(6,7).

This osteotomy has not intrinsic stability. The most common complication is metatarsal shortening.

##### Mau Osteotomy

This osteotomy is also known as reverse Ludloff osteotomy. It starts from proximal plantar part of the first metatarsal, goes in an oblique line and ends at distal dorsal part of the bone(8)(Figure-2). It is also not intrinsically stable but have more intrinsic stability than Ludloff osteotomy.

At Sammarco modification, a second osteotomy is performed to proximal plantar metatarsal metaphysis so the osteotomy has more contact area and also it provides more correction (8).

##### Scarf Osteotomy

It is a 'Z' like osteotomy. First, an osteotomy performed parallel to metatarsal shaft and two oblique osteotomies added from proximal and dorsal ends of the first osteotomy. Distal short osteotomy ends at dorsal surface and proximal short osteotomy ends at plantar surface(3)(Figure-3).

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The correction is provided by translation of the osteotomy line. Proximal and distal short osteotomies cannot provide enough space for rotational correction. This osteotomy has intrinsic stability.

The most common complication of this osteotomy is troughing(Figure-4). The modifications try to decrease this risk of this complication(9).

#### Offset V Osteotomy

This osteotomy is a modification of distal Chevron osteotomy but in this osteotomy, dorsal wedge of distal Chevron osteotomy ends much more proximally. So this osteotomy is accepted as a metatarsal shaft osteotomy.

Osteotomy starts from dorsal proximal of first metatarsal and ends distal plantarly with a second wedge osteotomy(3)(Figure-5). This osteotomy is intrinsically stable.

#### Baran-Unal Osteotomy

This osteotomy is mainly a modification of Mau osteotomy but it has much more osteotomy contact area and it provides more correction than Mau osteotomy. So it may be named as a new osteotomy type(2).

Osteotomy starts from distal dorsal part of first metatarsal, goes along a straight line to proximal plantar part and ends with a second wedge osteotomy 5 mm distal to tarsometatarsal joint(2)(Figure-6). It is also an intrinsically stable osteotomy.

#### Discussion

Concerning the results of metatarsal shaft osteotomies like Ludloff, Mau, Scarf, offset V and Baran-Unal osteotomy, favorable results have been reported as well as complications. It is well recognized that shaft osteotomies require appropriate techniques and wide surgical interventions.

There are some studies to compare shaft osteotomies each other and also with proximal and distal osteotomies. Nyska et al reported that Ludloff osteotomy had greater correction capacity rather than classical Mau osteotomy and the reason may be the more distal rotation center of Mau osteotomy (6). In our previous study, we compared five metatarsal shaft osteotomies and their screw fixation

stabilities and Mau, Offset V and new Mau modification(Baran-Unal osteotomy) got better results than Ludloff and Scarf osteotomies(2).

Trnka et al found Scarf, Ludloff, Mau osteotomies more stable than Chevron and proximal crescentic osteotomies. Mau was the most stable osteotomy type in their cadaver study(10). Nyska et al reported greater stability in Ludloff osteotomy compared to proximal crescentic and proximal Chevron osteotomies but Ludloff osteotomy was associated with metatarsal shortening(9). Acevedo et al – in their Sawbones bone model study- found no difference between stabilities of Ludloff and chevron osteotomies and proximal chevron osteotomy found more stable than Scarf and proximal crescentic osteotomies(3). Giannini et al. reported similar better results with Scarf and SERI(simple, effective, rapid, inexpensive) distal metatarsal osteotomies(11).

The most common fixation method of metatarsal shaft osteotomies are screw fixations. Cortical screws, cannulated screws or compression screws can be used. At least two screw should be used to avoid extra rotation of osteotomy and improve stability. Plate fixation is not suitable for shaft osteotomies because of cortical positioning after correction. K-wires may be used as an alternative for screw fixation. But k-wires have no compressive features and they are not stable as screws so early weight bearing cannot be possible after k-wire fixation. If you have no suitable place for second screw, k-wires are a good alternative to improve fixation stability of one screw. My preferred fixation method for metatarsal shaft osteotomies is two headless cannulated compression screw fixation.

Offset V and Baran-Unal osteotomies increase the contact area of the Chevron and Mau osteotomies as so they are suitable for severe deformities unlike Chevron and Mau cannot. Additional wedge osteotomies to the primary shaft osteotomy (like Offset V, Baran-Unal and Scarf osteotomies) increases the intrinsic

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stability of the osteotomy and early weight bearing may be possible.

All metatarsal shaft osteotomies have some general and specific complications and disadvantages. Ludloff osteotomy does not have intrinsic stability so early weight bearing may not be possible and specific complication of Ludloff osteotomy is metatarsal shortening. Classical Mau osteotomy is a short segment osteotomy so severe angles may not be correction by Mau osteotomy. Specific complication for Scarf osteotomy is troughing so this osteotomy may be problematic in older and osteoporotic patients. Coetzee et al reported some complications like troughing, rotational malunion, metatarsal fracture and early recurrence and high complication rates with prospective series of Scarf osteotomy(3). Offset V and Baran-Unal osteotomies have no specific complications. Their most common problem is the bone stock problem for performing multipl screws. Offset V osteotomy have thin dorsal proximal part and Baran-Unal osteotomy have thin dorsal distal part.

There is still no ideal osteotomy type for hallux valgus correction. Metatarsal shaft osteotomies have greater capacity for the correction of mild, moderate and severe hallux valgus deformity. All metatarsal shaft osteotomies and their modifications have good clinical results. Their high osteotomy contact area and practical fixation are the other advantages. All metatarsal osteotomies as so the shaft osteotomies have also some disadvantages. Appropriate technical applications and new improvements may provide higher success to metatarsal shaft osteotomies. Newer modifications may decrease the complications and improve union of the osteotomy.

Finally, an ideal metatarsal shaft osteotomy must correct all degrees of hallux valgus deformities, have high intrinsic stability, high osteotomy contact area, easy surgical application, practical and inexpensive fixation, to allow early weight bearing. The osteotomies with wedges (Offset V and Baran-Unal osteotomies) may provide all of these criteria so theoretically may be accepted as ideal.

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References

- 1- Richardson EG. Disorders of hallux. In: Canale ST, Beaty JH, editors. Campbell's operative orthopaedics. Vol. 4, 11<sup>th</sup> ed. Philadelphia: Mosby Elsevier; 2008. p: 4471-586.
- 2- Unal AM, Baran O, Uzun B, Turan AC. Comparison of screw-fixation stabilities of first metatarsal shaft osteotomies: a biomechanical study. Acta Orthop Traumatol Turc. 2010;44(1):70-5
- 3- Rockett MS, Goss LR. Midshaft first ray osteotomies for hallux valgus. Clin Podiatr Med Surg, 2005;22:169-95
- 4- Sanhudo JAV. Correction of moderate to severe hallux valgus deformity by a modified chevron shaft osteotomy. Foot and ankle International, 2006;27(8):581-5
- 5- Coetzee JC. Scarf osteotomy for hallux valgus repair: dark side. Foot and ankle International, 2003;24(1):29-33
- 6- Bae SY, Schon LC. Surgical strategies: ludloff first metatarsal osteotomy. Foot and Ankle International, 2007;28(1):137-44
- 7- Crevoisier X, Mouhsine E, Ortolano V, Udin B ve ark. The scarf osteotomy for the treatment of hallux valgus deformity: a review of 84 cases. Foot and Ankle International, 2001;22(12):970-6
- 8- Sammarco VJ. Surgical strategies: mau osteotomy for correction of moderate to severe hallux valgus deformity. Foot and Ankle International, 2007;28(7):857-64
- 9- Coetzee JC, Rippstein P. Surgical strategies: scarf osteotomy for hallux valgus. Foot and Ankle International, 2007;28(4):529-35
- 10- Pinney S, Song K, Chou L. Surgical treatment of mild hallux valgus deformity: the state of practice among academic foot and ankle surgeons. Foot and ankle International, 2006;27(11):970-73
- 11- Giannini S, Cavallo M, Faldini C, Luciani D, Vannini F. The SERI distal metatarsal osteotomy and Scarf osteotomy provide similar correction of hallux valgus. Clin Orthop Relat Res. 2013 Jul; 471(7):2305-11.

Figures

Figure-1: Ludloff Osteotomy



Figure-2: Mau Osteotomy



Figure-3: Scarf Osteotomy



Figure-4: Troughing(Specific complication for Scarf osteotomy)



Figure-5: Offset V Osteotomy



Figure-6: Baran-Unal Osteotomy

