Extensor Digitorum Brevis tendon transfer

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- Dane Wukich, MD receives royalties from Arthrex Surgical
Lesser digital deformities
  - Multiplanar
    - Crossover Toe
  - Surgical challenge
Technique Tip

- Level IV evidence
- EDB and biotenodesis screw
- Controlled tension
- Allows for stability for multi-planar correction
Instability at MPJ
  - SAGITTAL
  - TRANSVERSE
  - MULTI-PLANAR

Imbalance of extrinsic & intrinsic muscles

Disruption of ligamentous support of MPJ

Ligament dysfunction of plantar plate/collateral ligaments
  - Acute trauma
  - Chronic attenuation
  - Inflammatory arthropathy
Plantar Plate Failure

Plantar plate failure → Sagittal deformity
Collateral Ligament Insufficiency

Collateral ligament insufficiency → Transverse plane deformity
Deformity → Subluxation/Dislocation of MTPJ
Corrective procedures:
- Arthroplasty
- Arthrodesis
- Metatarsal osteotomies
- FDL transfer

Complications
- Joint stiffness
- Recurrent deformity
- Swelling
- Continued pain
- Loss of toe flexion
EDB Tendon Transfer

- Proximal tenotomy of the EDB maintaining insertion to the dorsal aspect of the proximal phalanx
- Tendon rerouted through drill holes in the base of proximal phalanx and metatarsal head/neck
- Recreates attenuated collateral ligament and reinforce the lax plantar plate
Adding the interference screw

- Utilizing the interference screw for proximal fixation of the tendon transfer
- Adds durable internal fixation with increased mobility and function
- Allows surgeon to recreate results with little technical difficulty
Materials and Methods

- Two year review of 6 surgical patients
  - 4 females
  - 2 males
  - Ages 35-62
- Painful rigid or flexible 2nd toe deformity
- Failed non-surgical treatment
  - Shoe gear modification
  - Taping
  - Splinting
  - Orthoses

- Inclusion criteria
  - Pain, digital elevatus, callus formation, crossover deformity, irritation with shoe gear

- Exclusion criteria
  - Previous surgery, compromising autoimmune disorder
Preoperative Planning

- Three Weightbearing Radiographs
  - AP
  - MO
  - Lateral
Surgical Technique

- Dorsal longitudinal incision
  - 2nd PIPJ to proximal metatarsal head
- Possible Z-lengthening of EDL
- Identify EDB and transect PROXIMALLY
  - Distal to musculotendinous junction
  - *EDB must be left intact at its distal attachment to the dorsal aspect of proximal phalanx
Surgical Technique

- 4-0 fiberwire whipstitch applied to EDB tendon
- 2nd MPJ capsulotomy
Surgical Technique

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- 2nd MPJ capsulotomy
Surgical Technique

- Release collateral ligament/plantar plate with McGlamry elevator
  - VALGUS deformity
  - Release contracted lateral collateral ligament
  - VARUS deformity
  - Release contracted medial collateral ligament

- Tendon routing and drill orientation dictated by type of deformity
  - VALGUS deformity
    - EDB routed to reconstruct medial collateral ligament
  - VARUS deformity
    - EDB routed to reconstruct lateral collateral ligament

VALGUS = lateral deviation
VARUS = medial deviation
Surgical Technique

- No sagittal deformity
  - Drill holes oriented transversely in proximal phalanx and metatarsal head
  - Parallel to WB surface

- Sagittal deformity
  - Drill holes oriented along oblique dorsomedial to plantarlateral axis
Deformity:
Dorsiflexed Varus 2nd toe

- Medial collateral ligament, dorsal capsule and plantar capsule released
- Guidewire placed in proximal phalanx from dorsomedial to plantarlateral
Deformity:
Dorsiflexed Varus 2\textsuperscript{nd} toe

- Second guidewire placed in metatarsal head, extending from dorsomedial corner of the articular surface to the plantarlateral metatarsal neck
Surgical Technique

- Tendon diameter is measured
- Drill first with 2.0mm drill bit and then 3.0mm drill bit if needed or augmenting with fibertape
  - Drill phalanx and metatarsal
- Transfer tendon through bone tunnel with use of tendon passer
Surgical Technique

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- Drill first with 2.0mm drill bit and then 3.0mm drill bit if needed or augmenting with fibertape
- Drill phalanx and metatarsal
- Transfer tendon through bone tunnel with use of tendon passer
- Pass tendon through phalanx base and enter tunnel on opposite side of the phalanx from the insufficient ligament
- Tendon exits phalanx plantarly and routed from plantar to dorsal through metatarsal bone tunnel
Surgical Technique

- Whipstitch technique allows toe to be tensioned quite easily
- Verify with intraoperative fluoroscopy
- Insert 3.0mm biotenodesis screw proximally
  - May add additional screw distally if using fibertape
Reassess Deformity

- Reassess hammered digit and need for additional surgery
  - Flexible deformity may no longer need addressed after transfer
- MTP may appear subluxed plantarly due to dorsal capsulotomy but resolves with repair and WB.
- Reapproximate EDL and close in anatomic layers
Post Operative Findings

- 120 day followup
- WB without difficulty in normal shoe gear
MTP Angle
## Post Operative Findings

<table>
<thead>
<tr>
<th>Preop AP°</th>
<th>Post op AP</th>
<th>% change</th>
<th>Pre op LAT</th>
<th>Post op LAT</th>
<th>% change</th>
<th>Follow Up (d)</th>
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<tbody>
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<td>9°</td>
<td>50%</td>
<td>30°</td>
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<td>26°</td>
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Post Operative Follow Up

- Alignment corrected in sagittal and transverse planes
- 2nd digit parallel to 3rd toe
- Purchased WB surface
  - Without PIPJ contracture or MPJ elevation, subluxation or dislocation
- 2 patients
  - Mild varus (medial drift) without hallux abutment
  - Severe deformity preoperatively
  - No pain
- Overall 100% satisfaction
Discussion

- Imbalance between extrinsic and intrinsic forces lead to lesser toe deformities
- MTP stabilized by medial and collateral ligaments, plantar plate, capsule and tendon forces
- Unopposed forces
  - Improper shoe gear, trauma, genetics, inflammatory disorder, neuromuscular disease
- Cadaveric study
  - Consistent transverse tears of plantar plate proximal to capsular insertion on proximal phalanx
  - Collateral ligament tears, complete plantar plate disruption noted in severe deformities

**Extrinsic:** EDL/FDL $\rightarrow$ extend MTP/flex PIP

**Intrinsic:** EDB/FDB/lumbricals/interossei $\rightarrow$ flex MTP/extend PIP
Their Technique

- Ellis et al.
  - Static technique

- Haddad et al.
  - FDL compared to EDB transfer
    - EDB transfer = less pain and stiffness
    - Higher rate of recurrence with increased severity of deformity

- Myers and Schon
  - Mini biotenodesis screw without phalangeal tunnel
  - EDB slip with Weil osteotomy

- Lui et al.
  - Secured distal stump of EDB to EDL
Our Technique

- Modified cannulated technique with biotenodesis screw for internal fixation
- To prevent frontal plane deformity seen with previous EDB transfers
- Allows for frontal plane control based upon the angle of orientation of the osseous tunnel
Results

- 2\textsuperscript{nd} MTP transverse plane deformity improved by an average of 20% (AP view)
- 2\textsuperscript{nd} MTP sagittal plane deformity improved by an average of 25% (LAT view)
Limitations

- Small patient population
  - New study being done with 20 patients with reproducible and improved results
To be continued….

- Applicable in lesser deformities
  - Also used in 3rd and 4th MTPJ pathology

- Multiplanar deformities are difficult to treat
  - Reproducible technique to help manage a challenging problem
References


- Unrelated procedures
  - Tarsometatarsal arthrodesis
  - Modified McBride bunionectomy
  - Akin ostetotomy
  - Proximal interphalangeal joint arthrodesis of the 3rd digit
  - 1st metatarsophalangeal joint arthrodesis
  - Neurolysis of the 3rd digital nerve
  - Partial ostectomy of distal phalanx hallux
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