Revision First Metatarsophalangeal Joint Arthrodesis with a Fused Circumferential Corticocancellous Autologous Iliac Crest Graft

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Statement of Purpose

The purpose of this study was to present our innovative technique of preparing and incorporating a fused circumferential corticocancellous autogenous iliac crest graft for a revision first MTPJ arthrodesis after a failed implant arthroplasty or other procedures that resulted in bone defect.

Literature Review

There is no single best graft that has shown successful union and patient function from a failed first MTPJ surgery. The use of an autologous iliac crest graft has been sparsely reported in the literature in the revision setting for foot procedures. Contradictory evidence exists in terms of a high rate of non-union using an autologous iliac crest graft as a bone block in a revision first MTPJ arthrodesis. (1) This finding may be attributed to the anatomic configuration of the graft, devoid of sufficient cortical and cancellous bone, that has been used. It is crucial to choose the appropriate graft to fill in the defect as the first MTPJ bears at least 25% hallux load of the bodyweight and assists during the toe-off phase in the gait cycle. (2)
Previous studies reporting a revision first MTPJ arthrodesis with bone loss have either utilized an autologous iliac crest graft, autologous calcaneal graft, or allograft.(3-6) (Table 1)The use of an ipsilateral calcaneal autograft resulted in a 75% union rate.(3) 87-91% union rate was achieved using an allograft.(4,5) Two previous studies have reported a union rate of 68-91.6% using an autologous iliac crest graft.(1,6,,7) The type of iliac crest autograft incorporated in the defect in previous studies was tri-cortical in configuration.(1,6,7)

Type of Graft	n	Union Rate	Complications
Calcaneal Autograft[3]	12	75%	2 hardware failure 1 superficial infection
Allograft[4]	11	90.9%	1 superficial infection
Allograft[5]	15	87%	3 cases of hardware impingement requiring removal
Tricortical Iliac crest autograft[6]	25	88%	2 cases of painful neuromas 1 chronic pain at graft site 3 cases of hardware impingement requiring removal
Tricortical Iliac crest autograft[7]	12	90.9%	1 hardware failure 2 cases of skin necrosis requiring surgical intervention
Tricortical Iliac crest autograft[1]	16	68%	1 deep infection 2 superficial infection
Allograft[1]	8	100%	1 sympathetic pain syndrome

Table 1: Union rates and complications using other types of grafts in previous studies

Methodology

- Nine consecutive patients who had undergone a revision first MTPJ arthrodesis with a fused autologous iliac crest graft between January 2013 and May 2016 were included in this study.
- Medical charts were reviewed for demographic and clinical details.
- Patients were postal mailed questionnaires assessing foot function and general musculoskeletal function using the revised-foot functional index score short form (R-FFI) and short musculoskeletal functional assessment (SMFA).

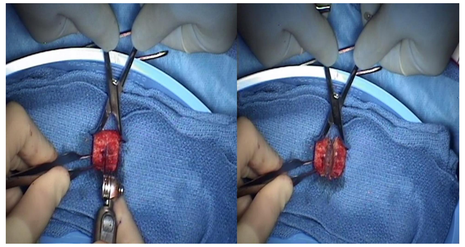

Figure 1: Splitting the autograft in two halves using a handheld motorized saw

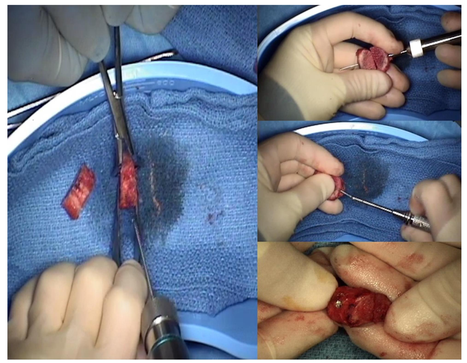

Figure 2: Preparation of the fused circumferential cortical rim graft using a 2.0 cortical screw in a lag technique

Figure 3: Insertion of the fused autograft in the First MTPJ defect internally fixed with a tubular plate

Surgical Technique

An autologous iliac crest graft was harvested. It was measured to the midpoint and was split in half. (Fig 1)
The 2 halves were re-approximated to from a graft circumferentially composed of cortical bone. A 2.0 cortical screw was used to fix the fused graft in a lag technique. (Fig 2)
The graft is placed within the first MTPJ defect in appropriate alignment and internally fixed with a semi tubular plate and 2.7 cortical screws to fix through the native bone. A 2.0 fully-threaded screw was placed with a washer in the middle hole of the plate overlying the graft to stabilize the graft to the plate. (Fig 3 and 4)

Post-operative Management

A non-weightbearing protocol for 6 weeks using a short leg cast with a toe plate and knee caddy was initiated. Patients were partial weightbearing from 6 to 9 weeks. At 9 weeks, patients were transferred to a CAM boot with partial weightbearing. Transition to athletic shoe wear was at 12 weeks after radiological union was achieved.

Figure 4: Intra-operative radiographic images after fixing the graft in the defect using a dorsal locking plate

Results

- There was a total of 9 patients who underwent the procedure. 1 patient deceased at 2 years post-operatively.
- 6/8 (75%) responded to the questionnaire at a mean follow-up of 42 months (18-64 months).
- The mean cortical graft length was 2.5 cm (1.2-4 cm)
- Clinical and radiological union was achieved in all patients (100%).
- Time to fusion was 12 weeks post-operatively.
- There was one hardware removal. One case of CRPS at the hip.
- The mean Dysfunctional and Bother indices were 11.5 ± 13.7 and 14.3 ± 16.2, respectively. The total R-FFI score was 31.4 ± 7.7. Both scores were out of 100 with a higher score denoting severe foot pain and disability.

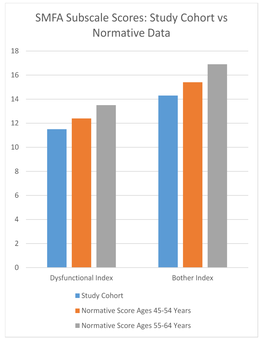

Figure 5: Comparison of SMFA with the normative

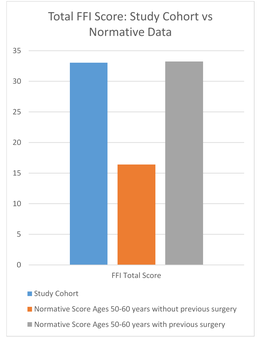

Figure 6: Comparison of Total R-FFI with the normative

Analysis and Discussion

- We compared our Dysfunctional and Bother indices (subscale scores of the SMFA) with the normative data of similar age range from a Dutch population available in the literature (Fig 5) We observed a 2 points difference in the Dysfunctional and Bother indices between our study cohort and the normative data, respectively. Our patients reported superior function compared to the normative data.
- The patients in our cohort had a lower total R-FFI score than normative scores in patients between the ages of 50 to 60 with a previous foot surgery (33.2 vs 31.4), indicating a better outcome. (Fig 6)
- Myerson et al reported the lowest rate of union using an autologous iliac crest, 5 out of 16 (68%). They hypothesized that this finding may have been due to lack of resorption and structural viability of the graft, especially the cortical portion.(1) We believe our technique in preparing the graft with a circumferential cortical rim probably overcame this anatomical limitation.
- By manipulating the graft, we were able to provide a fully circumferential corticocancellous bone graft providing a greater area of contact for bony union and filling in bone defects of great volume with satisfactory functional results.

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Financial Disclosures: None