

## Medial column fusion for degenerative pesplanovalgus deformity. Report of 9 patients

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**Degenerative pesplanovalgus is a progressive disabling condition; there are more than one surgical procedure used in the treatment with varied outcomes. The aim of the current study is to highlight the benefits of the medial column fusion surgery in the treatment of this condition. Nine adult patients with rigid degenerative pesplanovalgus (without significant valgus heel deformity) underwent medial column fusion between January 2015 to December 2020. The procedure was combined with subtalar fusion in four patients and lateral column lengthening in one patient. The mean follow-up period was 19.5 months (range, 15–27). Regular clinical and radiological reviews was carried out in the postoperative period. The mean Manchester Oxford foot score was good in 7 patients, and fair in two patients. The mean Meary angle was  $5.8 \pm 5.4^\circ$  preoperatively and improved to  $0.9 \pm 7.7^\circ$  at final follow-up, and the mean Pitch angle also improved from  $12.5 \pm 3.7^\circ$  preoperatively to  $23.2 \pm 4.1^\circ$  ( $P < .001$ ). In a patient, and at a different stage, talo-navicular fusion was added to the medial column fusion. The outcome of this series of cases was encouraging and medial column fusion continues to be a good option in the management of rigid pesplanovalgus deformity.**

**Keywords:** adult rigid flatfoot, arthrodesis, osteotomy, medial column.

### INTRODUCTION

The posterior tibial tendon dysfunction remains the most common aetiology in flatfoot disease; a condition which is common in middle aged patients especially among the female gender (3%)<sup>1</sup>. With the development of foot deformity, the failure of the Spring and Deltoid ligaments lead to changes in joint position (mainly the talonavicular joint), resulting in joint degeneration of the mid-foot and hind foot<sup>2</sup>. Brearton divided the stage II of Myerson classification of tibialis posterior dysfunction into A stage (early stage) and B stage (late stage). In Stage II-a, the arch of the foot slightly or moderately flat; Over 35% of the talonavicular joints are uncovered. Stage II-b shows the arch of foot is collapsed, with mid-talus-navicular joint abduction, and over 35% talus-navicular joint is uncovered. As the disease progress, this uncovering of talus increases<sup>3,4</sup>. Lee points out that stage III patients are with rigid flat foot, fixed hind foot deformity, stiffness, accompanied by a certain degree of osteoarthritis<sup>5,6</sup>. As the posture of the foot progresses into hind foot valgus and forefoot abduction through attenuation of the medial structures of the foot, the medial column begins to change shape. The first ray elevates, and the joints of the medial column may begin to collapse.

No single procedure or group of procedures can be applied to all patients with adult flat foot because of the variety of underlying aetiology and grades of deformity. Medial column fusion is in the armamentarium described to correct adult flat foot<sup>7-9</sup>. The deformity being addressed should include abduction or collapse through the navicular, naviculo-cuneiform, tarsometatarsal joints and or the talo-navicular joint. Triple arthrodesis is effective in stabilizing joints and relieving pain, however Tang has found that triple arthrodesis has some defects in remodelling the arch of the foot and improving the force line of hind foot<sup>6</sup>. Triple arthrodesis and medial wedge calcaneal osteotomy, the use of tricortical iliac bone graft is reported to improve the shape of the arch of the foot<sup>7,8</sup>. Reported results conclude that the stabilization of the medial column is a reasonable option for treating selected patients with severe and rigid planovalgus feet by providing a stable and pain-free foot, recreating the anatomy, and allowing the use of braces or regular shoes<sup>9,10</sup>.

The current paper evaluates the outcome of a series of patients with rigid flat foot who underwent medial column fusion mixed with other procedures when needed.

## PATIENTS AND METHODS

This retrospective study included 9 adult patients with degenerative pesplanovalgus deformity managed in Scarborough hospital between January 2015 to December 2020. All these patients underwent medial column fusion. The apex of the pesplano valgus deformity, is reconstructed to recreate the medial column, by extended and combined fusion of medial column joints as deemed necessary. The inclusion criteria included: adult-elderly patients with flat foot and mild valgus heel deformity; degenerative hind and mid foot disease, caused by chronic tibialis posterior insufficiency; 4 patients had Myerson stage IIA tibialis posterior dysfunction and stage IIB, in 5 patients.

Exclusion criteria included diabetic neuropathy/Charcot foot, peripheral arterial disease, adolescent flat feet and post-traumatic flat valgus foot deformity caused any abnormality above the ankle area.

The average age at the time of surgery was 59 (range 25-72) years. The left foot was involved in 4 cases and the right in 5 cases. Average follow-up duration was 19.5 (range, 15-27) months after surgery. Four of these patients had prior surgery on the same foot.

Preoperative detailed medical history and physical examination including the clinical assessment of the whole lower limb to identify the site of peak joint deformity which has led to the elongation of the medial column of the foot. The range of movement of the hind and mid-foot joints, the peak of the deformity and any neurovascular status were assessed. Above ankle valgus deformity were excluded from the study.

Routine X-ray included weight bearing antero-posterior and lateral films of both feet to analyse the radiological changes and the degree of navicular uncovering, subluxation/dislocation, and assessing the severity of the osteoarthritis. Preoperative radiological examination included Meary angle, and Kite angle.

Magnetic image resonance (MRI) examination/ Ultrasound scan was performed when needed to assess the condition of posterior tibial tendon and mid/hind foot joint arthritis. CT or three-dimensional CT reconstruction was also used to determine the arthritic joints. The apex of the deformity in the nearby joints, which may laterally deviate with time, are to be included in the fusion to avoid recurrence.

Under general anaesthetics, intravenous prophylactic antibiotics and tourniquet, a medial transverse incision is placed in-between the base of the first metatarsus and the tip of the medial malleolus. When the subtalar joint need fusing, through the same approach, the flexor retinaculum is released and the subtalar joint

is exposed and the neurovascular structures, tibialis posterior and other tendons are protected through out the procedure. The medial column joints to be fused are identified. Mini-Carm is used to identify the joints and the position of the plate and screws. The articular surfaces were exposed using Hinterman retractor and laminar spreader. An oscillating saw and osteotomes are used for the excision of the articular surface. When the talo-navicular joint is to be fused, the joint is reduced in supination and dorsolaterally; a temporary K wire is used for maintaining the reduction prior to the internal fixation. Stryker T 10, medial column plate is used, which comes in different sizes and lengths, is used for the fixation. If the subtalar joint is arthritic and the heel is in valgus, it is fused in neutral, or 5-degree valgus heel position using two auto fix Stryker headless screws or cannulated 6.5 screws. A mini C-arm is also used to check the correction of the following foot radiology angles to the to the preoperative radiographs.

– 1. Meary angle (is the angle between a line drawn along the longitudinal axes of the talus and the first metatarsal axis on the lateral view; an angle  $>4^\circ$  convex downward indicates pes planus.

– 2. The calcaneus pitch angle is an angle of the calcaneus and the inferior aspect of the foot, on the lateral view; the normal range is (18-32°).

A below knee plaster slab is applied to keep for 2 weeks and the patient is allowed mobilizing without weight bearing. The plaster slab is removed after two weeks, and the wound is checked. A below knee none weight bearing light cast is to continue for 4 further weeks. Deep vein prophylaxis is prevented using sub-cutaneous Daltaparin injection 5000 for 6 weeks. The cast is removed 6 weeks after surgery and gradual weight bearing in a walking boot is then allowed.

Standing foot and ankle check X-rays are taken at 3, and 6 months after surgery to evaluate the fusion and implant complications. At the final follow-up, Manchester Oxford foot score is recorded.

## RESULTS

Final review was conducted on all the 9 patients, Manchester-Oxford score was completed at the last follow-up.

The procedures performed were as follows:

– 1. Four patients underwent, medial column fusion Talus to the base of the first metatarsal) with subtalar joint fusion

– 2. One patient underwent lateral column lengthening (Evans's) procedure in addition to medial column fusion.

– 3. Three patients underwent medial column fusion (talus to the first metatarsal).

– 4. In one patient, the fusion included naviculocuneiform and base of the first metatarsal.

The results are considered good, if the pain relief and the deformity correction is significant and the Manchester Oxford score (mean final score 10) has improved with radiological improvements of the foot angles, and bony union. Patients younger than 55 were able to go back to work (3 patients) within three months of surgery.

The results were considered to be fair (mean Manchester score of 15) for patients who have developed mild recurrence of the pesplanovalgus deformity (two patients); one of which needed revision surgery to include the talo-navicular joint. At the last follow-up, all the patients were able to walk full weight bearing without pain, enjoyed recreational activities. At the time of final follow-up, all the nine patients were pain-free. The visual analogue (VAS) pain score was markedly reduced from a mean of 7/10 to 2/10. Three cases complained of mild pain which continued for an average period of 6 months (3-8 months) after surgery, one of screws was broken. The mean VAS for these three patients was 5/10, in the first 6 months and became 1/10 after 6 months.

All patients developed stiffness in the midfoot, however patients were satisfied for being able to walk plantigrade and move the ankle and toes. All but three patients witnessed a significant improvement of the pain, and improvement of the shape and gait in the first 6 months of surgery, and in the three patients, the improvement significantly improved after 6 months. No patients had difficulty walking on even ground, two patients struggled to walk on uneven ground. The leg swelling continued for an average 3 (2-8 months). Fair results; were patients who took longer than 3 months to get satisfactory results because of delayed union, implant breakage and if requiring further surgery. Most patients managed normal supportive shoe wear.

Pre- and postoperative values of MOXFQ-Index, VAS scores, and radiologic measurement included Meary, Pitch angles were recorded.

Whitney U-test was used for non-normally distributed continuous variables and t-test was used for normally distributed variables. Statistical significance was accepted for  $P$  values  $<0.5$ . The statistical analysis was performed using SPSS Statistics version 16.0 software (SPSS Inc., Chicago, Illinois, USA). The mean preoperative Manchester Oxford Q index was 68.5, the mean of the score became 45 in 6 months, this is significant ( $p$  value  $<0.001$ ).



Fig. 1. — Pre and postoperative radiograph of a case of pesplanovalgus treated with medial column fusion.



Fig. 2. — Pre and postoperative pesplanovalgus deformity treated by medial column, subtalar and talonavicular fusion.

The mean Meary angle decreased from  $5.8 \pm 5.4^\circ$  preoperatively to  $0.9 \pm 7.7^\circ$  at final follow-up.

The mean calcaneal Pitch angle improved from  $12.5 \pm 3.7^\circ$  preoperatively to  $23.2 \pm 4.1^\circ$  ( $P < .001$ .)

Bony bridges across the fused site were considered to be in favour of bony union, Fig. 1 and 2.

Overall patient satisfaction was rated as good in 7 patients with, fair for 2 patients. They developed recurrence of valgus deformity at the talo-navicular joints in one patient, which required further intervention and the talo-navicular joint needed to be refused. The second patient was happy with the pain relief and the improvement in walking, an insole was used instead of revision of surgery.

Implant breakage: there were 4 screw breakages in asymptomatic patients; radiographs of the foot showed bony union despite the screw breakage.

## DISCUSSION

Triple arthrodesis is considered to be the procedure for managing acquired rigid pesplanovalgus, there however is debatable. The common complications of triple arthrodesis are non-union, varus deformity of hind foot, secondary arthritis of the remaining joints of the mid foot and the ankle joint, infection of the surgical site, and the failure of internal fixation. Wallinget al performed triple-joint arthrodesis on 25 patients with flatfoot<sup>11</sup>. One patient (4%) had talo-navicular joint non-union after operation; 2 patients (8%) had calcaneal varus deformity due to the inadequate correction of the flatfoot; 1 patient (4%) had no significant improvement in pain after operation, and the arch of foot failed to return to normal height. Mann et al performed triple-joint fusion on 18 cases of adult flatfoot. At the last follow-up, the AOFAS score increased significantly, but 3 patients developed bone non-union<sup>11</sup>.

The results of double arthrodesis (talonavicular and subtalar joints) through a medial approach were better. Brillhault et al, evaluated 14 patients treated using double arthrodesis. The average follow-up time in this series was less than 21.5 months<sup>12,13</sup>. All deformities were corrected and there were no non-union. Jackson followed up 8 patients with 100% fusion rate of double arthrodesis ; the average fusion time was 5.25 months. In another study, of double fusion, 26 patients were followed up, the calcaneal valgus deformity and flat arch deformity were corrected<sup>14</sup>. In the current series, there was no non-union, however, there were 3 delayed unions which eventually united. The calcaneocuboid joint fusion was not performed and was not considered to be necessary in the correction of the pesplanovalgus deformity. In the current study, only one incision on the medial side was used for when medial column fusion in all, but one patients who needed Evans's procedure to lengthen the lateral column through a lateral incision. Evans's procedure was performed to aid in the correction and equalizations of the medial and lateral column. We have noticed that the longer the medial column, the more joints needed to be fused in order to shorten the column, this can be further improved by lateral column lengthening if need be.

## CONCLUSION

Medial column fusion through a single incision without the inclusion of the calcaneocuboid joint provides a reliable surgical option in the correction of rigid pesplanus deformity. We recommend involving the talonavicular joint in the medial column fusion when involved.

*Declaration of interest:* none.

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