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Calcaneal Stop Procedure for Treatment of Pediatric Flexible Flat Foot

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Abstract

Premature patients are more likely to suffer from flexible flat feet. This disease may be treated using a variety of methods. It may be treated with ease and simplicity using the calcaneal stop. According to our findings, this method is a worthwhile one. Methods and Subjects: A calcaneal-stop surgery was conducted on 20 feet in 12 individuals, seven men and five females, with flexible flat feet. They used the following criteria to determine who should be included: (a) skeletal immaturity; (b) symptomatic flexible flatfoot deformity (pain, function, and activity limits) that is not amenable to conservative therapy. AOFAS Ankle–Hindfoot score and Hindfoot valgus angle were used in the clinical examination. The results were reported back to the patient. Calcaneal pitch angles, Kite's angle, talar declination angle, lateral Meary's angle, and talonavicular coverage angle were used for radiological examination. All patients' clinical and functional results were assessed before, three and six months after surgery, respectively. A total of 88.4 SD 7.4 AOFAS scores were recorded at the conclusion of the trial, an increase from 70.6 SD 4.8 at the beginning. During the course of the research, the patient's heel valgus went from an average of 11.45 (SD 3.02) to a median of 2.7 (SD 1.3). Ending the investigation, the angle of the calcaneal pitch rose from 13.4 to 16.1 (SD 1.1). Kite angle decreased from 29.6° (SD 3.1°) to 26.7° (SD 2.7°) after surgery. A decrease from 22.4 to 11.2 (SD 5.68) was seen in the final talonavicular coverage angle. At six months following surgery, the lateral Meary talocalcaneal angle dropped from 20.55 6.9 to 14.3 4.73. Eleven patients (91.6 percent) were quite satisfied, and the one patient who had some discomfort at the location of the procedure did not need the removal of the screw. All clinical and radiological markers improved significantly (p .00001). After surgery, most of the alterations occurred. Although the progress was steady, it was not statistically significant. It is the patient's discontent that is the most pressing issue with flat feet. For the treatment of flexible flat feet, the calcaneal stop operation is a simple and straightforward surgery with little risks.

Keywords: flexible flatfoot, calcaneo-stop, sport, pediatric patient.

1. Introduction

Flat feet are a result of an inherited ailment that progresses and develops over a person's lifetime. They indicate a decrease in the medial arch of the foot. In addition to the abduction of the forefeet, talus is a planetary structure that rotates medially. During non-weight-bearing or tip-toeing, the flexible flatfoot presents a typical medial arch, however this arch is absent when the talus head protrudes medially. The valgus posture of the Calcaneus is evident [1, 2].

There are three types of surgical procedures for treating this condition: soft tissue, bony (osteotomy or arthrodesis), and arthroereisis. A bone operation, such as arthroereisis, should be performed after the first. [3]

Joint-saving method to repair flat-foot with foot function was devised for children's treatment with arthroereisis. It was developed by Grice in 1952 in an effort to repair flat feet in children with paralytic flat feet. Using sub-talar motion restriction without fusion, Haraldsson and Lelievre proposed sinus tarsi blocking. Arthroereisis operations operate on this concept. A temporary staple across the subtalar joint was employed by Lelievre to highlight the term arthroereisis [4].

The calcaneal stop method, on the other hand, was invented by Recaredo. Talus mobility was restricted by using a cancellous screw in the lower leg. This entrance site was found to be in the sinus tarsi thanks to an image analysis technique. Magnan and his colleagues found that 83 percent of patients had a positive outcome after a hundred and twelve-month follow-up period in their study [5].

The concept presented for calcaneo-stop and sinus tarsi arthroereisis operations is to provide a correction that continues after the implant is removed. Biomechanical and neuro-proprioceptive theories support this conclusion [6**].**

2. Material and Methods

At least 20 feet were treated using the calcaneal-stop method in 12 individuals with flexible flat feet as part of the clinical study mentioned above. They used the following criteria to determine who should be included: (growth cartilage may be seen on radiographs) [1] skeletal immaturity; [2] flatfoot that is symptomatic and flexible (pain restricts activities and function); and [3] therapy with calcaneal-stop surgical intervention. In order to be excluded, patients had to be free of neurological or neuromuscular diseases or posttraumatic flatfeet, among other things.

Calcaneal stop procedure7 was the surgical method used. General anaesthesia is used during the procedure. A proximal tourniquet is applied to the leg. All patients are placed in supine decubitus with their feet internally rotated. It is necessary to make a 2 cm long incision at the sinus of Tarsi **fig.** (1). As a result, the soft tissue is dissected in a rough manner. To prevent further subtalar eversion, the screw head is placed directly against the side of the talus with a length of 30–35 millimetres in the calcaneus **Fig.** (2), which is then drilled vertically **Fig.** (3). The drill bit is 3.2 mm in diameter and placed vertically **Fig.** (2) in order to drill inferiorly from superiorly against the sinus tarsi. When the knee is completely extended, the

dorsi-flexion of the foot is measured while the screw is correctly inserted and radiographically checked in neutral position. If following screw insertion the dorsi-flexion of the foot in the neutral position at five to ten degrees cannot be reached, concurrent lengthening of the gastrocnemius or Achilles tendon may be done. Patients received a two-month post-surgery rehabilitation routine that included proprioceptive exercises and stretching, but not running or jumping. All patients are required to have clinical and radiological follow-up after a period of 4 to 6 weeks. In the second two months after surgery, patients are encouraged to resume their favourite activities (sporting).

Clinical and functional outcomes of all patients were evaluated, before surgery, after surgery and at 6 months after surgery fig (4). Clinical evaluation was done using the American Orthopedic Foot and Ankle Society (AOFAS) Ankle–Hindfoot score7, and Hindfoot valgus angle8. Radiological assessment

was done with Calcaneal pitch angles6, Kite's angle6, lateral Talar-first metatarsal angle (Meary's angle)2, and Talonavicular coverage angle9.

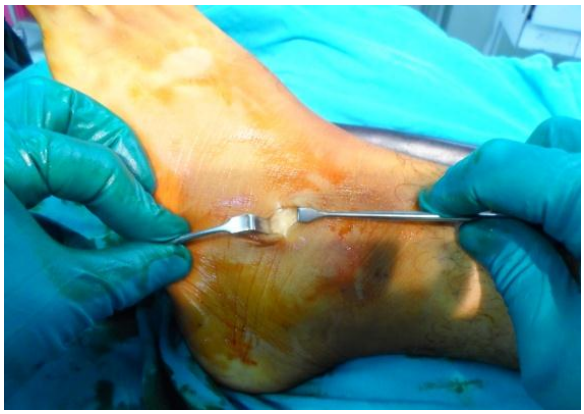

Fig. (1) incision at sinus tarsi

Fig. (2) drilling of calcaneus

Fig. (3) Calcaneal screw at position.

Fig. (4) Photos of pre (A) and postoperative (B) correction of left foot

3. Results

On the AOFAS Ankle– Hindfoot score (table 1), there was progressive improvement with time (P-value p is < .00001). The mean value after operation was 83.5±7.9. At the end of the study it was 88.4 ±7.4. Clinical Heel valgus (table1) showed significant improvement after surgery. The mean value after operation was 2.8 ±1.3 compared to 11.45 ±3.02 preoperatively.

Calcaneal pitch angle (table 2) showed significant changes (p < .00001). The mean calcaneal pitch angle (table 2) after operation was16.1 ± 1.6 (15-18). There were non-significant changes at the end of the study of this angle. The Kite angle and talonavicular coverage angles (table 2) which reflect mainly coronal plane movement, showed significant changes after operation (p < .00001). The mean Kite angle immediately after operation was 26.8 ± 2.5 (24-30). That of talonavicular coverage angle immediately after operation was 11.45 ± 6.03(3-20) However there was no significant changes at the end of the stud

Lateral Meary's talocalcaneal angle (table 2) showed also improvement indicating correction of sagittal plane. Mean postoperative value was 14.7 ±4.73 in comparison to 20.55± 6.9 preoperatively. There was one female patient (8.33%) which was complained of pain at site of surgery. However there was no need for screw removal. No other complication was present.

Table (1) Clinical parameters

	Preoperative	**Immediately** Postoperative	**At final follow up**
AOFAS Ankle–Hindfoot score	M 70.6 SD 4.8	M 83.5 SD 7.9 t-test 10.83	M 88.4 SD 7.4 t-test 13.92
Heel valgus	M 11.45 SD 3.0	M 2.8 SD 1.3 t-test 12.48	M 2.7 SD 1.3 t-test 12.38
M, Mean; SD, Standard deviation			

Table(2) radiological parametersy.

	preoperative	**Immediately Postoperative**	**At final follow up**
Calcaneal pitch angles	M 13.4 SD 1.1	M 16.1 SD 1.6 t-test 7.0	M 16.1 SD1.4 t-test 7.5
Kite's angle	M 29.6 SD 3.1	M 26.8 SD 2.5 t-test 7.4	M 26.7 SD 2.7 t-test 7.6
Talonavicular coverage angle	M 22.4 SD 5.4	M 11.45 SD 6.0 t-test 6.9	M 11.15 SD 5.7 t-test 7.5
Meary's angle	M 20.55 SD 6.9	M 14.7 SD 4.73 t-test 7.1	M 14.3 SD 4.73 t-test 7.7
M, Mean; SD, Standard deviation			

4. Discussion

The benefits of treatment for flexible flat feet have yet to be determined. Due to the absence of a globally agreed categorization system for improvement, as well as a dearth of high-level evidence-based research for variation management, this issue has arisen. [10]

Surgery to stop the subtalar joint from moving without fusion, such as calcaneal stop, A minimally invasive implant that acts as a barrier to the calcaneus to prevent eversion is a legitimate and successful surgery for the therapy of flatfoot in children that is idiopathic and prevents movement of the subtalar joint. It offers fewer side effects and a quicker recovery time. Rapid, minimally invasive and cheap surgical therapy of this problem may be achieved with this method [11].

An implant that restricts the mobility of the sinus tarsi was used to limit movement of the sub-talar joint while enhancing the position of the weight-bearing foot. Using a calcaneal stop method for paediatric flexible flatfoot therapy is quick and painless, and it restores the foot's natural arch in the process. For the most part, pes planus surgery is used to alleviate symptoms rather than improve the foot's structure [6].

The AOFAS Ankle–Hindfoot score showed improvement in our assessment of 20 feet of patients' complaints. The AOFAS Ankle-Hindfoot score produced comparable results in a 410-foot research by Pavone V et al 6. Despite this, the gap between pre- and post-operative results was greater than that of our research, which found that the mean difference between pre-operative and post-operative results was 79.3 5.7. Preoperatively, it was 70.6 4.8; postoperatively, it was 88.4 7.4 in our research. Both, however, were significant (p .00001), and Pavone V et al's study lasted up to three years after surgery.

Using the same measure, Hamed H 11, found a significant difference between pre and postoperative outcomes. Preoperatively, the mean value ranged from 56.76 (48-73) to 95.29 (90-100; p0.001). His study had a total of 52 feet in it.

The most common cause of idiopathic flexible flatfoot in children is a valgus heel with excessive pronation. The talus may planter and medially deviate in this posture. When it comes to therapy, correcting heel valgus and hyperpronation11 is the primary goal. After the removal of the screw, Hamed H's research demonstrated significant improvement in heel valgus with no recurrence. Compared to preoperative values of 11.45 3.02, our research found that the mean postoperative value was 2.8 1.3. Both investigations revealed a considerable rise in the quality of life.

There were also considerable improvements in our research and the other trials that used radiological assessment. Kite's angle, Talar declination, and Calcaneal inclination angles were all employed in our analysis, in addition to Pavone et al .'s. Pavone et al. also employed Costa-angle Bertani's in addition to these angles.

In Pavone et al's research, the kite's angle decreased from 31 0.82 to 24.91 1.77, but it increased from 29.6 3.1 to 26.7 2.7 in ours. Pavone et al. found that the talar declination angle decreased from 43.31 5.32 to 29.96 2.3, but our investigation found that it decreased from 41.9 5.0 to 32.8 4. Compared to Pavone et alresearch, .'s where calcaneal pitch angles went from 12.54 1.38 to 16.74 1.16, our investigation found that they went from 13.4 1.1 to 16.1 1.4. P .00001), which means that all of them were very significant.

In addition to Meary's angle, talohorizontal angles, talo-first metatarsal, and talonavicular coverage angles, calcaneal inclination was employed in Hamed's research. Statistically, all of these aspects of his research improved significantly. Talocaineal and AP Talocaineal angles did not show statistically significant improvement, however there was improvement in angle [11].

Meary's angle and talonavicular coverage both improved significantly throughout the course of the research we conducted on the subject. There was no statistically significant improvement over time.

Despite the fact that all parameters, clinical and radiological, improved after surgery, there were no significant changes in radiological parameters over time compared to improvements in clinical variables.

At one year postoperative, the mean AOFAS score was 96.4 4.5 (79 to 100) and at three years postoperative, it was 97.3 4.5 (90 to 100). The OxAFC, FADI, and FADI Sport clinical markers they employed showed comparable changes.

AOFAS's mean value rose from 83.5 7.9 (75-100) to 88.4 7.4 in our research (80-100). At no point in the Hamed trial were there any chronological analyses of the patient's postoperative results.

Radiological studies haven't changed much over time.

The screw's internal splint effect and proprioception accommodation may represent patients' adaptation to their new foot position, as might these clinical improvements.12.

Among his seventeen patients (12.5%), Pavale et al. discovered a few minor complications, including five patients (3.7 percent) who experienced pain at the surgical scar site, four patients (2.9 percent) who experienced local symptoms at the surgery site, and three patients (1.2 percent) who had a loosen screw alongside four patients (2.9 percent) who had an infection that was superficial. Screw breakage occurred in just one out of every 73 cases (or 0.73%).

In one example (1.9 percent), Hamed identified an overcorrection, and the patient was readmitted to have the screw buried farther into the calcaneus. Walking for lengthy periods of time caused discomfort in six youngsters (11.5 percent).

Pain at the surgical site was mentioned by just one female patient in our research (5%). However, analgesia was all that was necessary. It eventually faded away.

5. Conclusion

It is normal for children to have flexible flat feet. In addition to hyper-mobility of joints, it may present as an independent condition or as a symptom of another illness in people who have poor muscle tone or ligament laxity. There are no high-level studies that support the superiority of alternative management options. [22]

Surgery is the only option for symptomatic pes planovalgus if conservative treatment fails. Pediatric pes planus may be effectively treated using the calcaneal stop method, which corrects the misalignment between the clacaneaus and talus to a normal position and offers long-term repair by triggering proprioception mechanisms in the sinus tarsi of the foot. [11, 12]

Patients' symptoms and radiological markers improved as a result of this investigation. The calcaneal stop is reversible, does not interfere with future therapy, and is minimally invasive with low complications [6].

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