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Original Research Article

Outcome study of operative treatment of displaced intra-articular calcaneal fractures by sinus tarsi approach & extensile lateral approach

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ABSTRACT

Background: Traditionally used extensile lateral approach for treatment of displaced intra- articular calcaneal fractures has reported high rate of soft tissue complications (30%). In attempt to lower the complication rates, various minimal invasive techniques were introduced likes Sinus tarsi approach etc.
Aim: To study the clinical & functional outcome of operative treatment of displaced intra- articular calcaneal fractures by STA & ELA.
Materials and Methods: This prospective study was conducted in a tertiary care teaching center for 1 year from July 2019 to June 2020 following clearance from institutional ethics committee (Human). Sander's type 2 & 3 closed fracture included and open fractures, sander's type 1 & 4, extra-articular fracture, severe osteoporotic bone and conditions affect the gait were excluded. 15 patients underwent STA and 15 patients underwent ELA. Clinico-radiological follow-up was done at 2, 6, 12 weeks and 6th month to assessed union, radiological outcome, functional outcome and complications. VAS for pain relief, AOFAS score for functional outcome.
Results & Discussions: Most were working middle age male mainly due to fall from height and road traffic accidents. Sander's type 2 and 3 were more common. STA had shorter operative time (54.20 ±4.48mins), less intra-operative blood loss (51.00 ±5.73ml) and less soft tissue complications (13.33%) compared to ELA (operative time = 70.80± 9.05mins, blood loss= 98.00 ±9.2ml, complications = 46.67%). Both groups had 100% union. STA had early pain relieved (at 6th weeks) but VAS score was similar in both groups at final outcome. No difference was observed in radiological parameters and AOFAS score at final follow-up.
Conclusion: STA gives better result than ELA in operative treatment of sander's type 2 and 3 calcaneal fractures.

1. Introductions

Fractures of the calcaneus remain one among the most challenging conditions for the orthopaedic surgeon.[1] Calcaneal fractures are one of the most disabling fractures in men, with frequent occurrence during the wage-earning period of life.[2] The rehabilitation process can be time-consuming, and take up to 9 months and even longer in 20 percent of patients. With an estimated average health related costs per patient calcaneal fractures are a large economic burden to society.[3–5] Calcaneal fractures account for approximately 2% of all fractures, with displaced intra-articular fractures comprising 60% to 75% of these injuries. Of patients with calcaneal fractures, 10% have associated spine fractures and 26% are associated with other extremity injuries.[1] 70% has involvement of the posterior subtalar joint, and approximately 80% of all fractures occur in male patients. Calcaneal fractures are rare in childhood; only 5% of all calcaneal fractures are seen in children.[2,6] Ninety

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percent of calcaneal fractures occur in men between 21 and 45 years of age, with the majority being in industrial workers; thus, the economic implications of this injury are substantial.[1]

There is a considerable amount of literature on calcaneal fractures and their treatment; however the best management approach has yet to be determined. The treatment of calcaneal fractures is complex and has to be individualized depending on patient characteristics and fracture type. Patient characteristics (e.g., age, comorbidities, substance abuse, smoking habits, psychological condition, and anticipated non-compliance) and the condition of the soft tissues are at least as important as the type of fracture as seen on the radiographs and CT-scan.[7–9] The therapeutic modalities for displaced intra- articular calcaneal fractures can be divided into conservative and operative management. The latter comprises both the open reduction and internal fixation (ORIF) and percutaneous reduction and internal fixation (PRIF). Conservative treatment, either functional or using Plaster-of-Paris, is generally applicable in fractures with minor displacement and compromised soft-tissues, as well as in patients with certain physical (i.e., diabetes, peripheral vascular disease) or psychological characteristics (i.e., low anticipated compliance or substance abuse). Since the mid-nineties, ORIF is considered the gold standard treatment for displaced intra-articular fractures of the calcaneus by most experts, as it generally provides overall good to excellent results and the ability to anatomically restore the subtalar joint.[2] Several open surgical techniques have been described in the past, of which the extended lateral approach has been applied most frequently.[10–13] Alternative operative techniques include a medial approach,[14] plantar approach, combined lateral and medial approach,[15] limited posterior approach,[16] and the sinus tarsi approach.[17,18] Disadvantages of the open repair include wound dehiscence and infectious complications, which may occur in up to 30 percent of patients.[19,20] In an attempt to lower the complication rates encountered with ORIF, various minimal invasive techniques were introduced to reduce and fix displaced fragments.[21] Several studies have described the clinical outcomes associated with the extensile lateral and sinus tarsi approaches. However, few studies have compared results of operative fixation of displaced intra-articular calcaneal fracture (DIACF) treated with the sinus tarsi approach versus those treated with the traditional extensile lateral approach. One study reported that the clinical results are similar between DIACF treated by the extensile lateral approach and those treated by a minimally invasive approach. However, the minimally invasive approach has a significantly lower incidence of wound complications and secondary intervention.[22,23]

2. Materials and Methods

This prospective study was conducted at the Department of Orthopaedics in a teaching institution for 1 year from June 2019 to May 2020 following clearance from the Institutional Ethics Committee (Human).

The study population consisted of all patients with closed displaced intra-articular calcaneal fractures with sanders type 2 & 3, age >18 years, patients giving informed consent and without contraindication to undergo anaesthesia. The patients with open calcaneal fractures, Sander Type 1 and Type 4 fracture, extra-articular calcaneal fracture, severely osteoporotic bone, the conditions affect the gait (paraplegia, quadriplegia, CVA), patient unwilling to give consent for surgery and patients who were medically unfit for surgery were excluded from our study.

Thorough history and clinical examination of the patient was followed by adequate X-rays (AP view, lateral view and axial view of the calcaneum, CT scan of calcaneum and all preoperative investigations. Patients were divided into two groups; group STA and group ELA. The first patient in our study was assigned grouping by opaque envelope method and the subsequent patients were assigned alternative grouping.

2.1. Surgical technique

Position-lateral, Tourniquet Surgical time was varying with 45-90mins while performed with tourniquet, Radiolucent table –fractures visualized in lateral and axial view.

2.2. Sinus tarsi approach

5 cm incision given over sinus tarsi, 1cm below the lateral malleolus toward the base of 4th metatarsal bone. The extensor digitorum bravis muscle was retracted above to expose the anterior process and posterior facet and the peroneal tendon was retracted inferiorly. The calcaneo-fibular ligament was identified and sectioned. Also, lateral capsulotomy was done and removed hematoma. The subtalar joint was distracted and disimpacted fractures fragment of posterior facet through the primary facture line and visualized the medial fragments. The lateral wall of the calcaneus was then exposed via sharp dissection with a thin periosteal elevator and retracted like a door to expose the depressed fracture fragment. One 4.0 mm K-wire was inserted into the calcaneal tuberosity from the lateral side to correct the calcaneal Varus deformity. The fracture at the medial wall was then reduced by inserting a narrow Langenbeck elevator deep into the medial wall along the original fracture line. After correcting the varus deformity, height, and length, one 2.0 mm K-wire was inserted to fix the medial column temporarily along the medial wall to the sustentaculum tali & checked under c-arm. The posterior facet was elevated by using the lamina spreader and Langenbeck elevator and fixed to the sustentaculum tali

temporarily using one or two 1.5-mm K-wires. While the lateral wall was impacted by compressing the heel to reduce the calcaneal width, another 2.0-mm K-wire was inserted into the anterior process to stabilize the tuberosity with the anterior portion and to support the posterior facet.

If the anterior fracture line extended to the calcaneocuboid joint, transverse lag screws were used to fix fractures of the anterior process. A 2.7 mm T-shaped mini-fragment locking plate with six to seven holes (Nebula) was selected for all the procedures. After being pre-bended according to the shape of the lateral wall, the locking plate was placed immediately beneath the posterior facet. The last step was the K- wire removed and the percutaneous positioning of cannulated screws through the posterior tuberosity directed toward the calcaneocuboid joint. The surgical site was irrigated with normal saline. The wound was closed in layers and applied below knee slab for 2 weeks.

2.3. Extensile lateral approach

The incision started approximately 2 cm above the tip of the lateral malleolus, just lateral to the Achilles tendon. This line is continued vertically toward the plantar surface of the heel. It is connected to a line drawn at the junction of the lateral foot and the heel pad.

Posteriorly, this line connected to the vertical limb; anteriorly, it may be curved up to follow the skin creases, ideally cantering over the middle of the calcaneocuboid joint articulation, or carried straight to the base of the fifth metatarsal. Once the initial incision is made, attention is then turned to the corner of the flap, which was raised as a subperiosteally, full-thickness flap in one piece and retracted the full thickness flap by the help of sutures, which were tied with flap. Once flap developed and were divided the inferior peroneal retinaculum and detached fibulo-calcaneal and talo-calcaneal ligaments from bone. The subtalar joint capsule was opened and hematoma was removed. The peroneal tendons and the sural nerves were retracted with the flap and were not exposed. The lateral wall was exposed with the help sharp knife and superolateral articular fragments were removed for better visualization and reduction of posterior facet. Mobilized tuberosity through primary medial fracture line by placed Schantz pin in tuberosity under guidance of C-arm and were reduced superolateral articular fragment to sustentacular fragment and provisionally stabilized with K-wires under guidance of C-arm. Also, corrected valgus and varus deformity with help of schanz pin. The posterior facet was elevated with help periosteal elevator and reduced anterior process and anterolateral fragment (s) to articular fragments to restore crucial angle of Gissane and provisionally stabilized with K-wires. Reduced tuberosity to body of calcaneus and provisionally stabilized with K-wires under guidance of C-arm. The lateral wall fragment was replaced and adds bone void filler as needed. Applied anatomical calcaneal plate (Nebula) from the anterior process of calcaneus into the most posterior aspect of tuberosity. The last step was removed the schanz pin and K-wire and surgical site irrigated with normal saline. Assessed stability of superior peroneal retinaculum and were repaired ligaments and retinaculum. Flap was closed sequentially from ends to apex and skin closure done in identical sequence. A below knee pop slab applied for 2 weeks.

2.4. Postoperative assessment

Postoperatively, patients pulse, blood pressure, respiration, temperature, SpO2, Input and Output were monitored. Antibiotics were continued in the post-operative period, I.V for 2 days f/b oral antibiotic. Analgesics were given accordingly. Blood transfusion was done depending on the requirement. Postoperative pain was assessed by VAS (visual analogue scale). The VAS score is determined by measuring in 10-centimetres from the left hand end of the line to the point the patients marks. Anatomical reduction & Fracture fixation– measured by both clinically as well radiologically – seen calcaneal height, width, length, bohlers angle, gissane angle etc. Non- weight bearing ambulation started on 3rd post-op day. Sutures were removed on 12 to 14th postoperative day & B/K cast applied for additional 4 weeks. Cast removed and ankle physiotherapy, weight bearing started on 10-12 weeks post op day. Neurological status is assessed. Motor, sensory and autonomic functions are assessed at Discharge. Patients were discharged from the hospital after/before stich removal and initial stabilization with self or assisted nursing care.

Follow UP- All patients were followed up at 2nd weeks, at 6th weeks, 3rd months & 6th months then at 3 month intervals up to the final visit. At every visit patients were assessed regarding-(a) Radiological parameters, (b) Visual analogue score –pain (c) Foot scoring System: Ankle-Hind foot Scale (AOFAS) (100 points Total), (d) Post-op soft-tissue complications (e) Radiological union.

3. Results

A total of 30 patients were selectively operated; 15 patients in group STA and 15 patients in group ELA. The patients were mostly young adults in the age group of 14-56 years of age with mean age of 35.67 ±10.74 years in group STA and 38.53 ± 9.52 years in group ELA. Male to female ratio was 4:1 and 6.5:1 in group STA and group ELA respectively. The calcaneal fracture occurred mainly due to fall or road traffic accident. Fall was found to be more common cause than road traffic accident. There was left-side predominance but this difference was not statistically significant. Sanders type 2 fractures were common in group but sanders type 3 fractures common in group ELA.

Table 1: Demographic data's

Variables	Group-STA	Group-ELA	P-values
Age	35.67 ±10.74	38.53±9.52	0.4456
Sex(Male/Female)	12/3	13/2	0.6242
Mode of injury (RTA/Fall)	5/10	6/9	0.70497
Side of involvement (R/L)	8/7	6/9	0.4642
Fracture types (Sander type 2/sander type 3)	8/7	6/9	0.5427

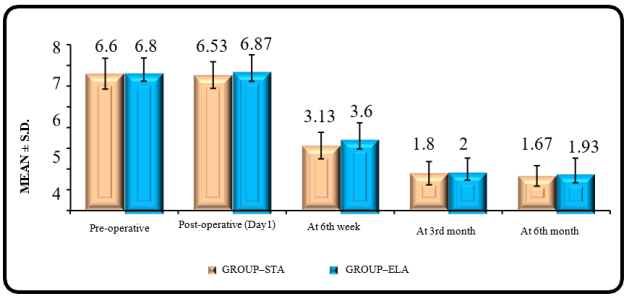
Sinus tarsi approach had shorter duration of surgery and less intra-operative blood loss as compared to extensile lateral approach, all variables were found to be statistically significant at p<0.01 (Table 2). All fractures got united in both groups (100% union rate) without any delayed union, nonunion.

Table 2: Perioperative parameters compared in both groups

Variables	Group-STA	Group-ELA	P-values
Duration of surgery	54.20±4.48	70.80±9.05	<0.001
Intra-op blood loss	51.00±5.73	98.00±9.21	<0.001
Union time	11.87±1.36	11.53±1.19	0.4797

The preoperative mean value of bohlers angle, gissane angle, calcaneal height, calcaneal width and calcaneal length were improved in both the groups. There was no significant difference of the mean value of different radiological parameters at final follow up in both the groups (Table 3).

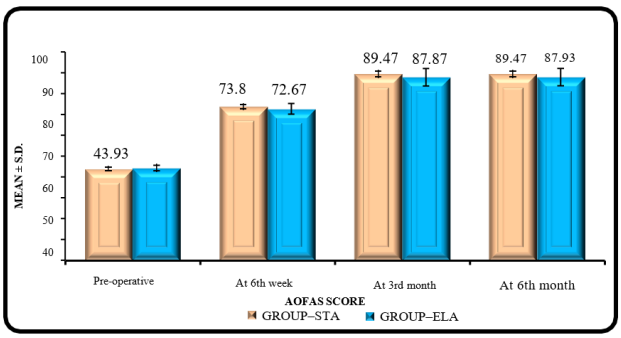
The Group-STA had early pain relief represented by a lower value of Visual Analogue Score (VAS) at 6^{th} weeks (3.13±0.64) as compared to the Group-ELA (3.60±0.63). However, VAS was found to be same in both group-STA and group-ELA at final follow-up (Graph 1). Both approaches of fixation had similar functional outcomes in terms of AOFAS at final follow-up (Graph 2).



Graph 1: Visual analogue score (VAS)

Table 3: Radiological parameters of both groups

Parameters	Group-STA	Group-ELA	P-value
Bohlers angle (°)			
Pre-op	16.02±1.42	16.60±2.23	0.4027
Post-op at 6th month	28.77±1.41	28.35±1.54	0.4355
Gissane angle (°)			
Pre-op	127.74±1.36	126.47±6.33	0.4552
Post-op at 6th month	119.62±1.94	119.06±0.92	0.3214
Height (mm)			
Pre-op	40.23±1.59	39.78±1.72	0.4593
Post-op at 6th month	43.52±1.00	43.29±0.62	0.4482
Width (mm)			
Pre-op	39.61±1.41	39.27±0.91	0.3050
Post-op at 6th month	35.88±1.30	35.33±1.63	0.3193
Length (mm)			
Pre-op	77.42±0.88	77.71±1.26	0.4755
Post-op at 6th month	75.34±0.90	75.71±1.15	0.3307



Graph 2: Mean comparison of AOFAS score at different follow-up

The post- operative soft tissue complications of wound edge necrosis, superficial infection, deep infection, peroneal tendinitis and subtalar stiffness were more in group-ELA than group-STA. No systemic complications were seen in both the group.

4. Discussion

Nowadays, the lateral extensile approach is considered the gold standard approach for displaced intra- articular calcaneal fractures, which provides great visualization of fractures and enough space to place the plate; however, postoperative complications include incision infection, skin flap necrosis, and osteomyelitis,[24,25] which bother surgeons. To minimize soft tissue trauma, surgeons have developed alternative approaches, such as percutaneous, arthroscopically-assisted, and small incision techniques. In

Figure 1: Extensile lateral approach - intraoperative pictures

Figure 2: Sinus tarsi approach -Intraoperative picture

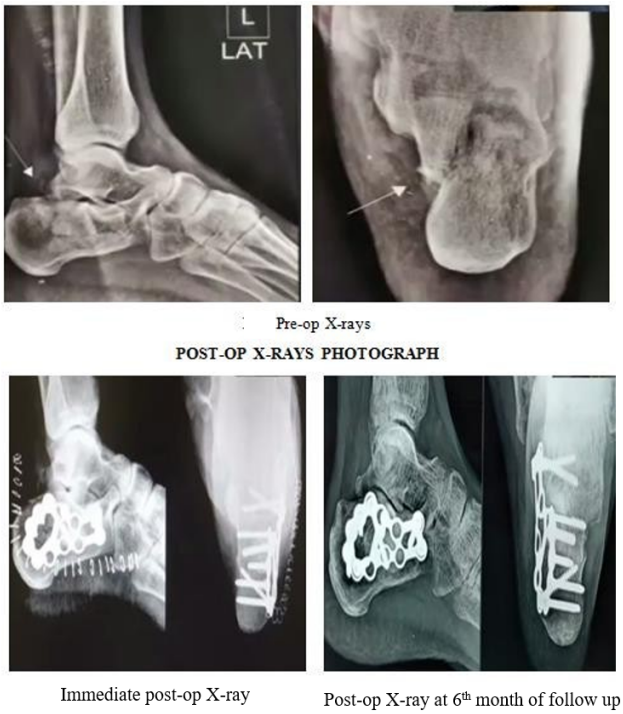


Figure 3: Case No.1: By lateral extensile approach

Figure 4: Case No.1: By lateral extensile approach

particular, the minimally invasive sinus tarsi approach has been widely recognized in the past a decade.

In this study, we have made an attempt to survey, evaluate, document and quantify the results of surgical management of displaced intra-articular calcaneal fractures through sinus tarsi approach and extensile lateral approach and compared in term of time between trauma to surgery, average blood loss, operative time, duration of hospital stay, fracture union rate, radiological outcomes, functional outcomes and complications.

In our study, the mean duration of surgery was 54.20±4.48 minutes in the group-STA while in the group-ELA; the mean duration of surgery was 70.80±9.05 minutes. This result shows significant difference of the mean duration of surgery between both the groups ($p < 0.05$). Shengli Xia et al[26] 2014 were found in their study that the operative time of the minimally invasive group was significantly shorter than that of the ELA group [46-80 min (mean, 62 min) vs 65-110 min (mean, 93 min), $p < 0.01$]. Je-hyong Yeo et al[23] 2015 found in their study that the mean duration of surgery was 61.7 minutes in the group-STA and 76.3 minutes in the group-ELA. Hai-chao Zhou et al[27] 2017 found the mean duration of surgery was 77.3±7.4 minutes in the group-STA and 83.1±8.4 minutes in the group-ELA. Bin jia, Wei Li et al[28] 2017 found the mean duration of surgery was 39.5±4.17 minutes in the group-STA and 62.4±6.58 minutes in the group-ELA. The results of these studies correlated with our study in term of the

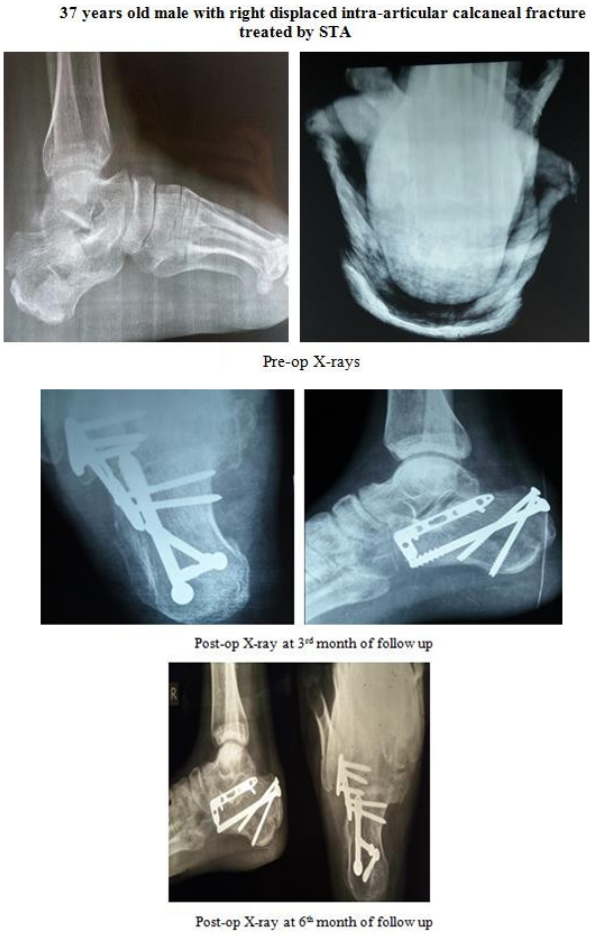


Figure 5: Case No. 2 – By Sinus tarsi approach

Figure 6: Case No. 2 – By Sinus tarsi approach

duration of surgery which was significantly less with the group-STA. The results of above studies were similar with our findings. The surgical duration in the group-STA might be less because we did minimally invasive open reduction under guidance of the fluoroscopy. The range of surgical duration in the group-STA was 50 to 62 minutes while in the group-ELA case was 60-88 minutes. The reason for a higher surgical duration in the group-ELA, might be a larger exposure required for reduction and plate fixation and technical difference from the group-STA and also required more time to repaired soft tissue.

The intraoperative average blood lost was 51.00±5.73 ml in the group-STA while in the group-ELA; intraoperative average blood lost was 98.00±9.21 ml. This result shows significant difference of the average intraoperative blood loss between both the groups ($p < 0.05$).Less blood loss in the STA procedure may be because of less duration of surgery and smaller exposure as compared to the ELA procedure. We had used tourniquet in both the groups. We did not find any intraoperative complication of vascular

Figure 7: Post-operative soft tissue complications

injury leading to excessive bleeding in any case in both the groups. Bin jia, Wei Li et al[28] 2017 found in their study that the average intraoperative blood loss were 21.6±3.45 ml in the group-STA and were 71.4±5.16 ml in the group-ELA. The findings of this study similar to our study and proved that the STA procedure is associated with significantly lesser blood loss as compared to the ELA procedure.

In our study, all fractures got united and there was no delayed union, malunion and non-union in both the groups. This result shows no difference between the two groups in term of union and union- related complications. The fracture mean union time were 11.87±1.36 weeks in the group-STA and were 11.53±1.19 weeks in the group-ELA. The results shows no significant difference of the mean union time between the two groups (p >0.05). Hai-chao Zhou et al[27] 2017 found in their study that the all patients gained bone union till the last follow up, the fracture were healed at approximately 10 weeks in both groups. Results of above study were similar to our findings. Jian Zou et al[29] 2017 were reported in their study that the all fractures healed till last follow up and the mean union time were 10 weeks. The findings of this study were similar to our study.

The mean post-operative radiological parameters were same on different follow up in both the groups. There was no significant difference between both the groups. On compared with other studies, the findings were nearly same. (Table 4)

In our study, the mean visual analogue score (VAS) at preoperative, postoperative D1 (Day 1), at 6th week, 3rd month and 6th month was 6.60±0.74, 6.53±0.64, 3.13±0.64, 1.80±0.56 and 1.67±0.49 respectively in the group-STA while in the group-ELA the mean visual analogue score at preoperative, postoperative D1, at 6th week, at 3rd month and 6th month was 6.80±0.56, 6.87±0.64, 3.60 ±0.63, 2.00±0.53 and 1.93±0.59 respectively. The mean value of VAS was little difference at 6th weeks and 6th month of follow up, but was no significant difference between in these both the groups. The pain was early relieved in the group-STA at 6th week of follow up. The mean VAS little more in group-ELA on last 3 follow up, may be because of larger soft tissue exposure and more soft tissue handing during surgery and wound complications.

Je-Hyong Yeo et al[23] 2015 found that the median visual analogue score were 2 points in the group- STA and 2 points in the group-ELA at final follow up. Attilio Basile et al[30] 2016 found that the mean VAS were 2.129±1.556 in the group-STA and were 2.275±1.371 in the group-ELA at final follow up. Hai-Chao Zhou et al[27] 2017 found in their study that the mean visual analogue score was 1.9±0.7 in the group-STA and were 2.3±1.0 in the group-ELA at final follow up.

Our study shows that, the mean AOFAS score was 89.47±1.30 at last two follow up in the group-STA and were 87.87±4.17, 87.93±4.17 respectively at last two follow up in the group-ELA. The AOFAS score were significantly improved postoperatively from preoperative value and the patients of the group-STA were early return of function than that of group-ELA at 6th week of follow up, but it was not significant The overall results according to AOFAS score were excellent in 8 (53.33%) cases, good in 7 (46.67%) cases in the group-STA and were excellent in 6 (40%) cases, good in 7 (46.67%) cases and fair in 2 (13.33%) cases in the group-ELA at last two follow up (at 3rd month & 6th month). This results shows no significant difference of the mean AOFAS score between both the groups (p-value>0.05). Ye-Hyong Yeo et al[23] 2015 found that the mean AOFAS scores were excellent in 60% cases, good in 37.5%, fair in 2.5% cases in the group-STA and were excellent in 50% cases, good in 46.6% cases, fair in 3.4% cases in the group-ELA and found no significant difference between both the groups. These results were similar with our study findings.

Our study shows that 1 (6.67%) case of superficial infection and 1 (6.67%) case of subtalar stiffness in the group-STA and were 2 (13.33%) cases of wound edge necrosis, 1 (6.67%) case of superficial infection, 1 (6.67%) of deep infection, 1 (6.67%) case of peroneal tendinitis and 2 (13.33%) case of subtalar stiffness in the group-ELA. The overall 13.33% local soft tissue complications were occurred in the group-STA and were 46.67% local soft tissue complications occurred in the group-ELA. This result shows that the overall local soft tissue complications in the group-STA was significantly lower than that the group-ELA ($p < 0.05$), but individual complication difference was not significant. The superficial infection were subsided by regular dressing and subtalar stiffness relieved by physiotherapy, wound edge necrosis and deep infection resolved by debridement and dressing. No secondary operation needed in both the groups. No systemic complications seen in both the groups.

The results of above studies shows that the findings of our study were similar with above studies and the local soft tissue complications were less with the group-STA than that of the group-ELA. The difference of overall soft tissue complications between the two groups were significant (p value <0.05).

5. Conclusion

In this comparative study of operative treatment of displaced intraarticular calcaneal fractures by Sinus tarsi approach and extensile lateral approach, we observed that both the approaches are equally effective and comparable in treating sanders type 2 and type 3 fractures in term of final radiological and functional outcome. Although, we observed that sinus tarsi approach (STA) has significant less soft tissue complications (eg. superficial & deep wound infections, wound edge necrosis, peroneal tendinitis etc.),

Table 4: The mean value of postoperative radiological parameters compared with different studies

Authors	Bohlers angle (STA & ELA)	Gissane angle (STA & ELA)	Height (STA & ELA)	Width (STA & ELA)
Je- Hyong Yeo et al[23]	26.5°, 25.3°	115.5°, 119.0°	45.1mm, 46.5mm	37.5mm, 39.3mm
Hai- Chao Zhou et al[27]	27.2±2.7°, 26.5±2.7°			
Bin Jia et al[28]	31.5±3.35°, 27.2±3.22°	116.5±4.82°, 120.4±4.51°	41.9±2.95mm, 39.2±2.87mm	32.3±2.14mm, 34.1±2.48m m
Present study	28.77±1.41°, 28.35±1.54°	119.62±1.94°, 119.06±0.92°	43.57±0.57mm, 43.35±0.57 mm	35.88±1.30mm, 35.33±1.63 mm

Table 5: Complications associated with these approaches seen by different authors

Authors	Complications	Group-STANumber (%)	Group-ELANumber (%)
Je-Hyong Yeo et al[23]	Wound complications	2 (5%)	8 (13.3%)
	Sural nerve injury	2 (5%)	4 (6.6%)
	Peroneal tendinitis	0	1 (1.6%)
	Subtalar arthritis	3 (7.5%)	5 (8.3%)
	Total	**17.5%**	**30%**
Hai-chao Zhou[27]	Superficial infection	1 (3.57%)	2 (5.4%)
	Partial skin flap necrosis	0	3 (8.10%)
	Subtalar joint stiffness	3 (10.71%)	7 (18.91%)
	Implants irritation	0	2 (5.4%)
	Handfoot deformity	0	4 (10.81%)
	Total	**14.28%**	**48.64%**
Bin Jia, Wei li et al[28]	Skin flap necrosis	1 (1.66%)	5 (8.33%)
	Wound infection	1 (1.66%)	3 (5%)
	Foot pain	1 (1.66%)	3 (5%)
	Neurological injury	0	4 (6%)
	Subtalar stiffness	1 (1.66%)	4 (6%)
	Total	**6.7%**	**31.7%**
Present study	Wound edge necrosis	0	2 (13.33%)
	Superficial infection	1 (6.67%)	1 (6.67%)
	Deep infection	0	1 (6.67%)
	Peroneal tendinitis	0	1 (6.67%)
	Subtalar arthritis	1 (6.67%)	2 (13.33%)
	Total	**13.33%**	**46.67%**

shorter duration of surgery, less intraoperative blood loss. Sinus tarsi approach also showed early pain relief and early return to function (AOFAS Score at 6th week of follow up) but it was statistically insignificant.

Hence, our hypothesis that the sinus tarsi approach is a better option than the extensile lateral approach in operative treatment of displaced intra-articular calcaneal fractures (for Sander type 2 & 3) is proven to be true in term of less soft tissue complications, shorter duration of surgery, less intra-operative blood loss but there is no difference in results in terms of union, radiological and functional outcome (level of activity).

The limitations of this study are lack of randomization and a single centre study on small sample size and shorter duration of follow up. Thereafter, further randomized observational studies on a large sample size and longer duration are suggested to conclusively ascertain the outcome.

6. Source of Funding

None.

7. Conflict of Interest

None.

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