

Surgical Treatment of Displaced Intra-Articular Calcaneal Fracture with Tri-Cortical Iliac Bone Graft

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Abstract

Management of displaced intra-articular calcaneal fracture has remained unclear for orthopedic surgeons and there is controversy to choose the best methods of treatment. Wide range of post-operative complications and variety of outcomes cause this complexity. Although, there is no strong evidence, in which support superior benefit of bone grafting in treatment of DIACF, it is still a popular method. The objective of this study was to present outcome and complications of surgical management of DIACF with tri-cortical iliac bone graft. Fifty-three cases containing 47 men (57 feet) and six women (7 feet) with DIACF underwent surgery by mean of tri-cortical auto graft bone from iliac crest. AOFAS hind foot scale (consist of subjective and objective variables including three major categories pain, function and alignment) and VAS questionnaires were used for full assessment of post-operative outcomes and complications. Mann-Whitney U test was used to compare means. The mean \pm SD AOFAS hind foot score was 88.18 ± 7.12 . AOFAS hind foot and VAS scores showed no significant difference between male and female. Nevertheless, better outcome of surgery among those below 35 year of age based on AOFAS hind foot score. Use of bone graft for treatment of DIACF might yield better results, however, the results probably differ in various conditions and situations. At the end, we recommend comparing results of different methods of treatment of DIACF by one large clinical trial with under the control of confounders.

Key words:

Displaced intra-articular calcaneal fracture; Bone graft; Calcaneus

Introduction

Calcaneal fracture is the most common site of injury among tarsal bones [1] and Intra-articular fractures accounted for about 75% of all calcaneal fractures [2]. Displaced intra-articular calcaneal fractures (DIACF) is usually made by vertical violence delivered to the foot [3]. After many years of studding, management of displaced intra-articular calcaneal fracture has remained unclear for orthopedic surgeons and there is controversy to choose the best methods of treatment such as plates, bone graft and void filler [4]. Wide range of post-operative complications and variety of outcomes cause this complexity. Wilmoth [5] carried out the first use of bone graft for surgical management of DIACF. Although, there is no strong evidence, in which support superior benefit of bone grafting in treatment of DIACF [6], it is still a popular method. Stimulating fracture healing, early full weight bearing, prevention of post-traumatic arthritis and increase in mechanical strength are counted as advantages of bone grafting [7,8]. On the other hand, some studies stated increase in infection rate, blood loss and post-operative pain as disadvantages of bone grafting [9,10].

The current study presents outcome and complications of 53 patients (64 feet) with DIACF that managed surgically with iliac bone graft.

Methods

Study population

One hundred and sixteen patients with calcaneal fracture were recruited for our study from April 1997 to May 2010 in Akhtar hospital, center of orthopedic surgery, Health Services and Medical Education, Tehran, Iran. Forty-five cases with extra-articular type of fracture were considered to treat conservatively and were excluded from the study. Among 71 eligible cases with displaced intra-articular calcaneal fracture, those with less than 2 years of follow up time and unavailable follow up data were also excluded. Finally, 53 cases containing 47 men (57 feet) and 6 women (7 feet) were included for our study.

Primary assessment

Plain radiography and computed tomography scans diagnostic tests were used to confirm fractures. Essex-Lopresti (E-L) classification system used to classify patients fracture.

Surgical technique

The operative procedure was performed when the soft-tissue edema decreased and the wrinkle sign was positive on hind-foot's soft tissue in few days after trauma. All surgical procedures were performed under general or spinal anesthesia, with the patient placed in the semi-lateral position, using standard L-shaped lateral approach and keeping lesser saphenous vein and sural nerve out. The skin incisions were L-shaped at beginning, over the lateral aspect of the heel with the

horizontal arm and vertical arm continued approximately at the mid-point between the tip of the lateral malleolus and the sole. Nevertheless, nowadays we do only transverse arm of previous incision. The peroneal tendons were moved proximally and the incision goes straight down to the periosteum and overall os calcis body. In this case, an oval shape or war shield bone, 1.5 × 1.5 cm, in lateral wall of the heel bone can be seen that is our landmark. By moving this war shield bone away with keeping its soft tissue attachment, then we ahead to center of fracture frontier, just the place that must penetrates by tip of periost elevator and dig the wides of bone all the way from lateral to medial cortex in coronal plan. Then under c-arm control by lamina spreader from this hole that created by periost elevator can expand the bone just like inflation of flat tire in vehicle. An important issue at this point is whether the plantar cortex of bone is intact or not. If not, we must put two parallel Steinman pin No 2.5 that enters from posterior tubercle of bone in conjunction to plantar cortex and pass the tip of pins out of anterior tubercle of os calcis to mid tarsal bones. Lamina spreader will lever its arm of fulcrum down on them until the second arm under posterior facet of os calcis and press the upper part of bone to the plantar aspect of Talus. Then by c-arm can control how much pressure by spreader is needed to get complete bone parts reduction .The next step is a tri-cortical auto graft bone from Iliac crest 2 in 2.5 cm in big defect of fracture site. The graft must enter in and pass the lateral cortex of host bone for 2 mm, so have enough space to put the war shield back to its own place. By closure of wound layer by layer we apply a short leg cast in 5-10 degree plantar flexion of ankle, the cast must be well-molded free coronal plan. Cast must keep the foot for four weeks.

At the end, the heel should be put in short leg cast by good mediolateral molding in 5-10 degree equinus for four weeks. Then the patient is asked for full weight bearing in active equinus position for 6 months.

Final evaluation

Precise full examination and radiographic X-ray evaluated operation results on months 1, 3, 6 and 12 post-operatives. In addition, The American Orthopedic Foot and Ankle Society (AOFAS) hind foot scale (consist of subjective and objective variables including three major categories pain, function and alignment) and visual analog scale (VAS) questionnaires were used for full assessment of post-operative outcomes and complications. According to AOFAS hind foot scale excellent result was defined as 90–100 points, good as 75–89 points, fair as 50–74 points, and poor as <50 points [11].

Statistics

Data summarized using mean ± SD (standard deviation) and frequency (percentage). Data was divided according to gender (male and female) and age (35< and ≥35). Mann–Whitney U test was used to compare mean ± SD between groups. All statistical analysis were performed by mean of SPSS version 20.

Result

Patients’ age ranged from 17 to 53 year (31.39 ± 2.85 yrs.). Mechanism of fracture was falling in 29 patients, motor-vehicle accident in 21 and suicide in three. Four of these, had fracture of L1 and L2 spines that needed no surgical treatment. According to E-L classification system, 23 patients had joint depression fracture type, 21 Tongue type and 20 Comminuted. Date of surgery was 2-7 days after

trauma with the exception of two patients that underwent surgery at 21th and 25th post-trauma days. Five patients had history of diabetes mellitus, 22 were smoker and six were addicted to opium.

All fracture healed within 6 months after surgery with a mean healing time of 2 months and 21 days. No complications including deep infection, wound edge necrosis, prolonged wound drainage, subtalar ankylosis and non-union was seen during follow up in our patients. Eight patients had joint narrowing in X-ray but only one of the m has joint line tenderness and all other seven had no complain. Time interval between operation and full weight bearing ranged from 4 weeks to 6 months.

Forty-nine, forty-five and six percent of cases displayed excellent, good and fair AOFAS score, respectively (Table 1). The mean ± SD AOFAS hind foot score was 88.18 ± 7.12. Although no difference was shown between male and female, there was significant difference comparing patients 35 years old and older to others (p=0.04). AOFAS hind foot score was According to AOFAS hind foot score, 31 patients had excellent results, 29 patients had good results and four patients had fair results. Mean ± SD VAS score was 0.85 ± 0.06 and no difference was observed between male and female and age groups (Tables 2 and 3).

AOFAS	Excellent	Good	Fair	Poor
All	31	29	4	-
Men	28	26	3	-
Women	3	3	1	-
Age < 35	23	16	2	-
Age ≥ 35	8	13	2	-

Table 1: AOFAS score of patients after surgery divided by sex and age group.

	All	Men	Women	P value
Number (%)	64 (100)	56 (87.5)	7 (12.5)	-
Mean age	31.39 ± 10.33	32.08 ± 10.26	26 ± 10.05	-
AOFAS hind foot score	88.18 ± 7.12	88.22 ± 6.72	87.85 ± 10.55	0.94
VAS score	0.85 ± 0.06	0.84 ± 0.06	0.86 ± 0.07	0.38
Age ≥ 35	8	13	2	-

Table 2: Comparing results of surgery by AOFAS hind foot score and VAS score in male and female.

	Age < 35	Age ≥ 35	P value
Number (%)	41 (64)	23 (36)	-
Mean age	24.18 ± 4.63	42.38 ± 5.87	-
AOFAS hind foot score	89.46 ± 6.79	85.91 ± 7.21	0.04

VAS score	0.86 ± 0.06	0.83 ± 0.07	0.1
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Table 3: Comparing results of surgery by AOFAS hind foot score and VAS score in two age groups.

Discussion

Conservative management of DIACF usually results in complications such as secondary arthritis and malunion of the calcaneum [12]. Therefore, ORIF is getting method of interest for treatment of DIACF. Although the use of bone grafting in management of DIACF have an old history in medical practice, its usefulness is not still clear [13]. Rate of definite and occasionally use of bone graft in ORIF has been reported to be 20% and 42% in nationwide study in Netherlands, respectively [14]. Wang et al. [15] used percutaneous reduction and internal fixation combined with fluid bone graft for treatment of 15 case of DIACF. After average of 18 months of follow, they reported no complication including wound infection, screw breakage and calcaneum varus. In addition, Singh et al compared two group of DIACF treated with and without autologous iliac bone grafting. Result showed 13.36% vs 12.7% subtalar arthrosis, 3.2% vs 3.4% subtalar fusion and 6.9% vs 5.8% infection rate in groups with and without bone graft, respectively. However, no statistically difference was reported. We found eight patients with joint narrowing; but only one patient reported clinical complication. Some authors have not suggested use of bone graft in treatment of intra-articular because of higher infection rate [9,16], but we observed no surgical site infection in our patients. Also, our graft choice is tri-cortical autologous bone that has tendency for enhancement of bone healing beside of its usefulness to keep the bone against different compressive or tensile loads relatively.

The result of this study revealed 48% excellent and 45% good AOFAS score. Worse [13] and better [15] outcomes have reported in other studies. A systematic review of literature comparing outcome of treatment of DIACF with and without bone grafting, displayed similar results for both methods [17], but after separating by reported score, patients with bone grafting had lower mean AOFAS score but a higher mean Creighton score. Although Different AOFAS score may show advantages of one method, it can replay different conception and feeling of pain and other variables. For example, those have been in wealth for a long time probably having a worse feeling of pain. As well as, result can vary by different surgical techniques and surgeon's surgical skill.

The primary limitations of current study were small sample size, no measurement of Böhler's angle and no Sandra classification. As well as, considering two groups with and without bone grafting in one study concluded stronger results than comparing results of two different studies, Because of same conditions including genetics and environment.

In conclusion, use of bone graft for treatment of DIACF might yield better results. However, the results probably differ in various conditions and situations. We recommend comparing result of

different methods of treatment of by one large clinical trial with under the control of confounders.

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