

Effectiveness of Compressive Stockings Utilization in the Management of Post-Operative Swelling for Ankle Fractures in a Teaching Hospital in Ghana

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Abstract

Background: Post-operative swelling following open reduction and internal fixation for ankle fracture is a common complication that delays return to function. Compressive stockings have been employed in most centres in Africa to help resolve such complications but there is a dearth of information regarding its clinical effectiveness. Therefore, this study sought to evaluate the effectiveness of compressive stockings in the management of post-operative ankle swelling. **Methodology:** A prospective cohort hospital-based study was employed in the present study to assess the effectiveness of compressive stocking in reducing post-op swelling following ORIF for ankle fractures compared to a control group who had no compressive stocking using a convenient sampling method. Data collected include age, sex, and ankle circumference at 2, 6 and 12 weeks post op. Based on the x-rays, the ankle fractures were categorized according to the Lauge-Hansen classification. Student t-test was used in all statistical analyses p-value <0.05 (95% confidence interval) was considered statistically significant. **Results:** A total of 85 patients (40 test and 45 control) including 54% males and 46% females between the ages of 18 - 78 years with

a mean age of 44.8 + 14.9 years were recruited for the present study. The most common fracture pattern was supination external rotation (74.1%). Post op swelling was significantly lower in the compressive stocking group compared to the control group at 6 weeks [0.53 cm (95% CI: 0.05 - 1.01), $p < 0.05$] and 12 weeks [0.42 cm (95% CI: 0.05 - 0.8), $p < 0.05$]. **Conclusion:** Compressive stocking can be used effectively to reduce post op swelling following open reduction and internal fixation for ankle fractures.

Keywords

Ankle-Fractures, Postoperative-Swelling, Functional-Outcomes, Compressive-Stocking, ORIF

1. Background

The ankle remains one of the most important weight-bearing joints in the human body [1]. Anatomically, the ankle joint is a modified hinge joint that consists of three bones: the tibia, fibula, and talus, which are bound by ligaments [2]. The complex structure of the ankle permits great strength and the ability to absorb a great amount of shock and pressure up to about six (6) times the individual's body weight [1]. Its nature also makes it one of the most common sites for fracture or injury.

Court-Brown *et al.* estimated that ankle fractures accounted for 10% of all fracture occurrences. Ankle fractures also accounted for 17% of fractures requiring hospitalization [3] [4]. The burden of ankle fractures is significant in Africa and may be due to road traffic accidents, falls from height and sports [5]-[7].

The goals of ankle fracture management are to restore anatomic alignment, ensure early ambulation, and promote early return to pre-injury functionality [6] [8]. Ideal functional outcomes are attained either non-operatively or operatively based on the modality of restoration of normal anatomy of the joint and maintenance of stability of the joint [9]. ORIF is now the gold standard especially for displaced, unstable closed fractures. It enables restoration of anatomical alignment and articular congruity of the ankle mortise [7] [10] and permits earlier resumption of the ankle joint range of motion [8] [11]-[13].

Complications associated with ORIF for ankle fractures include postoperative swelling, surgical site infection, pulmonary embolism, wound margin necrosis, residual pain, and post-traumatic osteoarthritis [10] [14] [15].

Post-operative swelling has specifically been noted to be a significant factor that may protract return to pre-morbid functionality [8] [16]. Compression therapy has been advocated as an intervention for such complications in most centres in Africa. However, there is less research conducted to elucidate its clinical efficacy. Also, a few studies conducted in most developed countries reported varying clinical outcomes with respect to compressive stocking usage [17] [18]. Therefore, the

present study sought to evaluate the effectiveness of compressive stockings in the management of post-operative ankle swelling in a Teaching Hospital in Ghana.

2. Materials and Methods

This study was conducted at Komfo Anokye Teaching Hospital, a tertiary hospital based in Kumasi that serves the middle and northern of Ghana. It was a prospective cohort hospital-based study that assessed the effectiveness of compressive stocking in reducing post-op swelling following ORIF for ankle fractures compared to a control group who had no compressive stocking post-ORIF. Participants who were 18 years and above with ankle fractures and had undergone ORIF were recruited for the present study. Individuals who were below 18 years and those with open fractures as well as those whose fracture was managed conservatively were excluded from the study. The study was carried out from April 2022 to March 2023.

Plain radiographs were done, and the fractures were classified using the Lauge-Hansen classification. The patients underwent ORIF using the AO/ASIF treatment protocols. Patients then underwent a standard postoperative regimen including analgesia, non-weight bearing and elevation of the operated ankle. Initial change of dressing was done on the third postoperative day with alternate day dressing till discharge. Wound care continued on an outpatient basis with removal of stitches at 2 weeks after surgery. Using a convenient sampling method, patients were grouped into two, those who had compressive stockings and those who did not. Ankle circumference was measured 5 cm proximal to the tip of the medial malleolus and ankle swelling was said to be present when the difference between the affected ankle and normal ankle was more than or equal to 1 cm. The measurements were taken at 2, 6 and 12 weeks after surgery. The AOFAS Ankle-Hind-foot score which was adapted from a similar study by Macera *et al.* [10] was used to evaluate the functional outcome.

Data was collected using a structured questionnaire. Data was stored and analysed using the Statistics for Windows, version 21 (IBM Corp., Armonk, N.Y., USA). Independent student t-test was used to analyse the difference between the treatment and control group. p-values lower than 0.05 were considered statistically significant.

Ethical approval was obtained from Komfo Anokye Teaching Hospital Institutional Review Board (KATH IRB/AP/141/21). Moreover, administrative clearance was sought from the management of KATH and the Trauma/Orthopaedic Directorate. Consent was also sought from the study respondents after the nature of the study was explained fully to them. The right to discontinue cooperating at any stage of the study was also made known to the patients. Confidentiality and anonymity were firmly assured to all the respondents and ensured throughout the study. All participants were further informed that the data collected will only be used for the purposes for which it was collected. Only the authors had access to the raw data.

3. Results

3.1. Descriptive Statistics of the Study Data

A total of 85 patients were including 54% males and 46% females between the ages of 18 - 78 years with mean age of 44.8 + 14.9 years were recruited for the present study. 40 participants were in the treatment arm whereas 45 were in the control group. The age group most affected in this study was 30 - 39 years followed by 50 - 59 years old group (Figure 1).

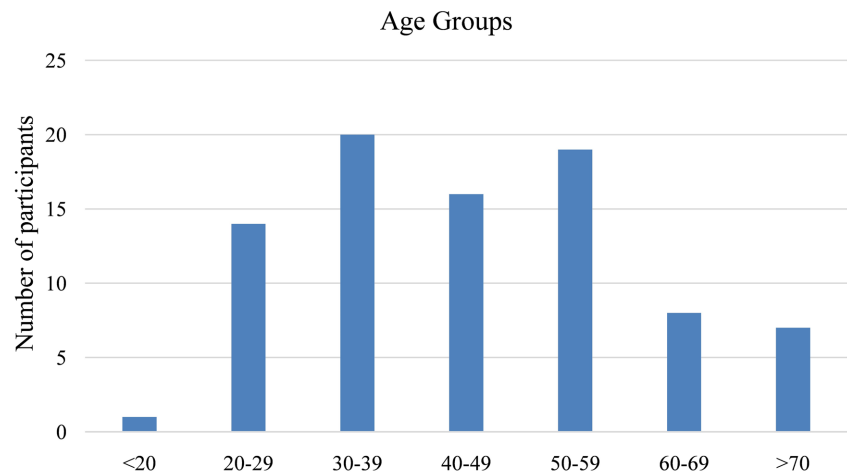


Figure 1. A bar graph showing the age group (in years) of the study participants.

The commonest type of ankle fracture recorded according to the Lauge-Hansen classification was the Supination-External rotation type (74.1%) followed by pronation-abduction (15.3%). Pronation-external rotation and Supination-adduction only represented 7.1% and 3.5% respectively as shown in Table 1 below.

Table 1. Distribution of ankle fracture type using Lauge-Hansen classification.

Classification of fractures	Frequency (n)	Proportion (%)
PAB	13	15.3
PER	6	7.1
SAD	3	3.5
SER	63	74.1

*PAB = Pronation – abduction; PER = Pronation – external rotation; SAD = Supination – abduction; SER = Supination – external rotation.

Following ORIF, 98.8% of the participants had swelling of the affected limb 2 weeks post-op.

Table 2 summarizes the difference between ankle circumference at 2, 6 and 12 weeks post-op. Average ankle swelling was 2.82 cm, 1.88 cm and 1.02 cm for all participants at 2, 6 and 12 weeks respectively. In both groups there was observable improvement in ankle swelling over the follow up period.

Table 2. Differences in ankle circumference for all participants.

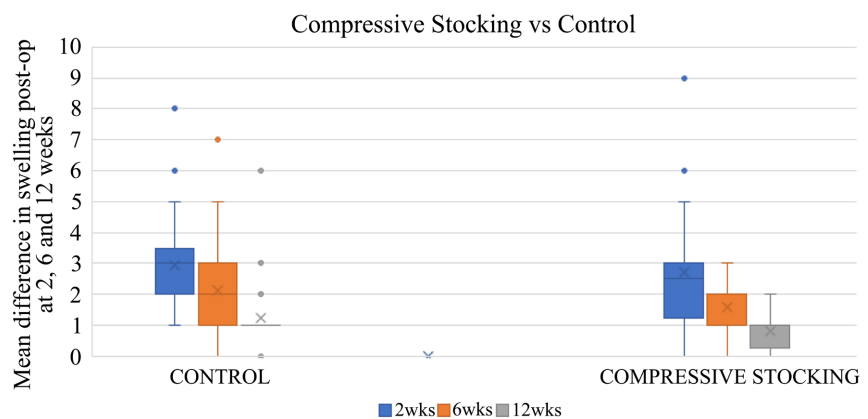
Post Op Duration	2 Weeks (Mean \pm SD)	6 Weeks (Mean \pm SD)	12 Weeks (Mean \pm SD)
Compressive Stocking	2.68 \pm 1.72	1.60 \pm 0.90	0.80 \pm 0.52
No Compressive Stocking	2.96 \pm 1.49	2.13 \pm 1.27	1.22 \pm 1.08
All Participants	2.82 \pm 1.60	1.88 \pm 1.13	1.02 \pm 0.89

3.2. Effectiveness of Compressive Stocking in Reducing Post Op Swelling

As shown in **Table 3**, ankle swelling was noted to be higher in the control group at 2 weeks, 6 weeks and 12 weeks post op. Using the student t-test, the difference was 0.23 cm [CI 95: -0.46 - 0.92, $p = 0.25$], 0.53 cm [CI 95: 0.05 - 1.01, $p < 0.05$] and 0.42 cm [CI 95: 0.05 - 0.8, $p < 0.5$] at 2, 6 and 12 weeks respectively. The difference, however, was not statistically significant at 2 weeks. The improvement in ankle swelling for both groups is demonstrated in **Figure 2** which shows more rapid resolution following use of compressive stocking.

Table 3. Effectiveness of compressive stocking in reducing post op swelling.

Duration Post-Op	Compressive Stocking, Mean \pm SD	Control Group Mean \pm SD	Difference in Swelling, [95% CI]	p-value
2 weeks	2.68 \pm 1.72	2.96 \pm 1.49	0.23 [-0.46 - 0.92]	0.25
6 weeks	1.60 \pm 0.90	2.13 \pm 1.27	0.53 [0.05 - 1.01]	0.015
12 weeks	0.80 \pm 0.52	1.22 \pm 1.08	0.42 [0.05 - 0.8]	0.013

**Figure 2.** A box and whisker plot comparing the effectiveness of compressive stocking usage between the test group (left) and the control group (right) over 2 weeks (blue box), 6 weeks (orange box) and 12 weeks (grey box).

4. Discussion

In the present study, more males had ankle fractures than females. This could be

attributed to males frequently engaging in more physical and high-risk activities than females [19] [20]. This finding agreed with another study reported by Kuubiere *et al.* who investigated characteristics of ankle fractures among Ghanaian populace in the Tamale Metropolis [6]. Contrary to this study, a population-based epidemiological study conducted in Brazil noted higher incidence of ankle fractures in older females which was attributed to poor bone quality/osteoporosis [8]. The predominance of the supination external rotation fracture observed in the present study was consistent with the findings of a prospective population-based in Denmark by Jensen *et al.* who reported higher incidence of SER (64%) among their study population [21].

4.1. Incidence of Postoperative Ankle Swelling after ORIF of Ankle Fractures

In the present study, about 98.8% of the study participants developed 2 weeks post-ORIF. Consistent with the present study's findings, D'Almeida *et al.* reported that although ORIF is generally effective, it is plagued with postoperative swelling [22]. Ng *et al.* also reported high incidence of postoperative ankle swelling after six weeks of ORIF [23]. The consistency of the present study with these studies strengthens the reliability of the findings and highlights the importance of addressing postoperative swelling as a common concern in ankle fracture management. High incidence of postoperative ankle swelling after ORIF could be attributed to both mechanical and biological mechanisms [24]-[26]. Literature attests that inflammatory response to surgical trauma increases the permeability of capillary walls and lymphatic outflow, which results in extravasation of fluids into the joints. Also, inflammatory mediators including histamine, prostaglandins, and leukotrienes, increase vascular permeability and cause more fluid to accumulate within the joints which exacerbate the degree of swelling [27] [28]. Moreover, the surgical incision may damage lymphatic veins, decreasing lymphatic drainage further compounding fluid accumulation [29] [30].

4.2. Postoperative Swelling in Both Compressive Stockings and Non-Compressive Stockings Groups

At six-week post-surgery, the study revealed a greater reduction in postoperative swelling in the participants who wore compressive stockings (mean swelling level of 1.60 ± 0.90) as compared to those without stockings (mean swelling level of 2.13 ± 1.27). The postoperative period is characterized by an intense inflammatory response resulting from tissue trauma during surgery. The application of compressive stockings during this phase may have contributed to mitigating swelling in the compressive stocking group compared to the non-compressive stocking group. By providing consistent compression, these stockings likely aided in reducing edema formation and promoting efficient lymphatic drainage, leading to a slight advantage in swelling reduction during the initial recovery stages. Interestingly, the most significant difference in ankle swelling was observed at twelve

weeks post-surgery. Patients in the compressive stocking group reported a mean swelling level of 0.80 ± 0.52 , while those without stockings had a mean swelling level of 1.22 ± 1.08 . At this stage, most fractures have healed, and the inflammatory response should have largely subsided. The substantial disparity in swelling levels between the two groups suggests that the benefits of using compressive stockings extend well into the later stages of recovery. By consistently providing compression and support, the stockings may have facilitated more effective resolution of any residual swelling, thereby enhancing overall patient comfort and functional recovery.

These findings aligned with similar studies in the literature that support the use of compressive stockings in reducing postoperative ankle swelling following ORIF of ankle fractures. *Sultan et al.* observed that compressive stockings significantly reduced postoperative swelling, with fractured ankles returning to their pre-morbid circumference within a month of use [29]. Similarly, *Rohner-Spengler et al.* reported improved preoperative swelling reduction in patients treated with a multilayer compression bandage pump [30]. These studies, along with the findings of the present study have demonstrated the potential benefits of compression therapy in managing postoperative swelling and promoting optimal recovery.

While compressive stockings show promise in reducing postoperative swelling, it is crucial to acknowledge the concerns regarding potential delays in wound healing. The literature indeed presents evidence to support this notion. However, it is important to note that the current study did not report on adverse effects on wound healing with the use of compressive stockings. The benefits of swelling reduction and improved patient outcomes observed in this study and corroborated by other research may outweigh the potential risks associated with delayed wound healing, especially when used judiciously and with appropriate wound care measures.

Healthcare professionals should consider incorporating compressive stockings as part of the postoperative care plan for patients undergoing ORIF of ankle fractures. By understanding the optimal timing and duration of compression therapy, clinicians can effectively manage postoperative swelling and enhance patient comfort and functional outcomes. It is essential to conduct further research to explore the long-term effects of compression therapy and optimize its use in ankle fracture management. With continued investigation and careful implementation, compressive stockings can continue to play a valuable role in improving the postoperative recovery journey for patients with ankle fractures.

5. Conclusion

The findings of the study suggested that ankle fractures occur predominantly in males and young adults, and the most common sustained ankle fracture pattern was supination external rotation IV. The incidence of postoperative swelling after open reduction and internal fixation of ankle fractures was almost universal (98%). Compressive stocking considerably reduced postoperative swelling at six

and twelve weeks following ORIF of ankle fractures. Generally, the functional outcomes after open reduction and internal fixation of ankle fractures were impressive. However, there was no statistical difference in functional outcomes between patients who had compressive stockings and those who did not.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest with any known entity or group.

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