

# Comparison of a Breathable Mesh Cast Versus Conventional Fiberglass Cast in Distal Radius Fractures: A Prospective Randomized Controlled Trial of 450 Patients

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## Abstract

**Background:** Distal radius fractures are among the most common fractures managed conservatively. Conventional fiberglass casts, although effective in immobilization, are frequently associated with patient discomfort, itching, sweating, and skin-related complications due to poor ventilation and moisture retention. Breathable mesh casts have been developed to improve ventilation, hygiene, and overall patient experience.

**Methods:** A total of 450 adult patients with closed distal radius fractures were enrolled in this prospective randomized controlled trial and equally allocated into two groups: breathable mesh cast (n = 225) and conventional fiberglass cast (n = 225). The primary outcome was patient comfort assessed using the Visual Analog Scale (VAS) for itching. Secondary outcomes included skin complications, patient compliance, and radiological fracture union. Statistical analysis was performed using independent t-tests and chi-square tests, with p < 0.05 considered significant.

**Results:** Mean VAS itching scores were significantly lower in the breathable cast group at all time points (p < 0.001). Skin complications occurred in 8.4% of patients in the mesh cast group compared with 25.3% in the fiberglass group (p = 0.001). Compliance was significantly higher in the mesh cast group (95.1% vs 84.0%, p = 0.006). Fracture union rates were comparable between the groups (97.3% vs 95.6%, p = 0.48).

**Conclusion:** Breathable mesh casts significantly improve patient comfort and reduce skin complications without compromising fracture healing, making them a superior alternative to conventional fiberglass casts.

**Keywords:** Breathable mesh, Cast, Distal radius fractures, VAS

## Introduction

Distal radius fractures represent one of the most frequently encountered injuries in orthopaedic practice and are commonly treated conservatively using casting techniques [1, 2]. Fiberglass casts have largely replaced plaster of Paris due to their strength, lightweight nature, and rapid setting properties [3]. However, their circumferential and non-ventilated structure creates a closed microenvironment that promotes sweat accumulation, increased humidity, and skin maceration [4, 5].

In hot and humid climates, these issues are further exacerbated, leading to itching, discomfort, foul odor, and poor hygiene beneath the cast [6]. Prolonged exposure to such conditions may result in xerosis, pigmentation changes, skin irritation, and, in severe cases, ulceration or infection [7]. These complications can negatively affect patient compliance and may necessitate premature cast removal, thereby compromising fracture management.

Recent advancements in casting technology have introduced breathable mesh casts designed with an open lattice structure that allows air circulation and moisture evaporation [1]. These casts aim to improve patient comfort, maintain skin integrity, and reduce

complications while providing adequate immobilization.

Despite increasing clinical adoption, high-quality randomized evidence evaluating their effectiveness remains limited. This study was conducted to compare breathable mesh casts with conventional fiberglass casts in terms of patient comfort, skin complications, compliance, and fracture union in a randomized controlled setting.

## Material & Methods

### Study Design

This study was a prospective randomized controlled trial conducted over 12 months.

### Study Population

A total of 450 adult patients aged 18–65 years with closed distal radius fractures suitable for conservative management were included.

### Inclusion Criteria

- Closed distal radius fractures
- Age between 18–65 years
- Indicated for conservative casting

### Exclusion Criteria

- Open fractures

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- Neurovascular compromise
- Polytrauma patients
- Pre-existing dermatological conditions

**Randomization**

Patients were randomized using a computer-generated sequence into:

- Group A (Breathable Mesh Cast): 225 patients
- Group B (Fiberglass Cast): 225 patients

**Intervention**

- Group A received a socket-type breathable mesh cast
- Group B received a conventional fiberglass cast

**Outcome Measures**

**Primary Outcome:**

- Patient comfort assessed using VAS for itching

**Secondary Outcomes:**

- Skin complications (rash, maceration, infection)
- Patient compliance
- Radiological fracture union

**Statistical Analysis**

- Continuous variables: Independent t-test
- Categorical variables: Chi-square test
- Significance:  $p < 0.05$

**Results**

**Baseline Characteristics**

The baseline demographic and clinical characteristics of patients in both groups were comparable, with no statistically significant differences observed. The mean age, gender distribution, and fracture characteristics were similar between the groups (Table 1).

**VAS Itching Scores**

The mean VAS itching scores were significantly lower in the breathable mesh cast group at all observed time points, indicating superior patient comfort. This difference was statistically significant ( $p < 0.001$ ). The trend of itching scores over time clearly demonstrates sustained comfort in the mesh cast group compared to the fiberglass cast group (Figure 1). Detailed numerical values are presented in Table 2.

This figure illustrates the progressive reduction in itching scores in the breathable mesh cast group compared to the consistently higher scores observed in the fiberglass cast group.

**Skin Complications**

The incidence of skin complications such as rash and maceration was significantly lower in the breathable mesh cast group. Overall complication rates were reduced from 25.3% in the fiberglass group to 8.4% in the mesh group ( $p = 0.001$ ). This comparison is visually represented in Figure 2, while detailed data are provided in Table 3.

The figure demonstrates a markedly lower incidence of dermatological complications in patients treated with breathable mesh casts.

**Compliance**

Patient compliance was significantly higher in the breathable mesh cast group, with fewer patients attempting early removal. This highlights improved tolerance and satisfaction with the mesh cast. The detailed findings are summarized in Table 4 and illustrated in Figure 3.

This figure highlights the higher compliance rates and reduced early

Variable	Group A (n=225)	Group B (n=225)	p-value
Mean Age	42.7 ± 11.8	42.1 ± 11.5	0.61
Male (%)	60%	62%	0.68
Extra-articular fractures (%)	72%	70%	0.73

Table 1: Baseline Characteristics of Study Population

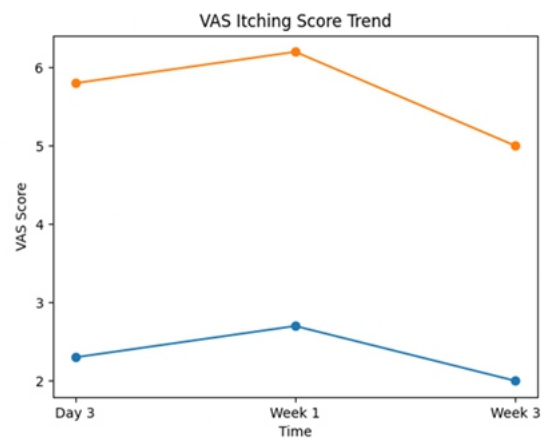


Figure 1: VAS Itching Score Trend

Time Point	Group A	Group B	p-value
Day 3	2.3 ± 1.1	5.8 ± 1.5	<0.001
Week 1	2.7 ± 1.2	6.2 ± 1.6	<0.001
Week 3	2.0 ± 0.9	5.0 ± 1.3	<0.001

Table 2: Comparison of VAS Itching Scores

Complication	Group A	Group B	p-value
Rash	9 (4.0%)	27 (12.0%)	0.006
Maceration	7 (3.1%)	24 (10.7%)	0.004
Infection	3 (1.3%)	6 (2.6%)	0.31
Total	19 (8.4%)	57 (25.3%)	0.001

Table 3: Comparison of Skin Complications

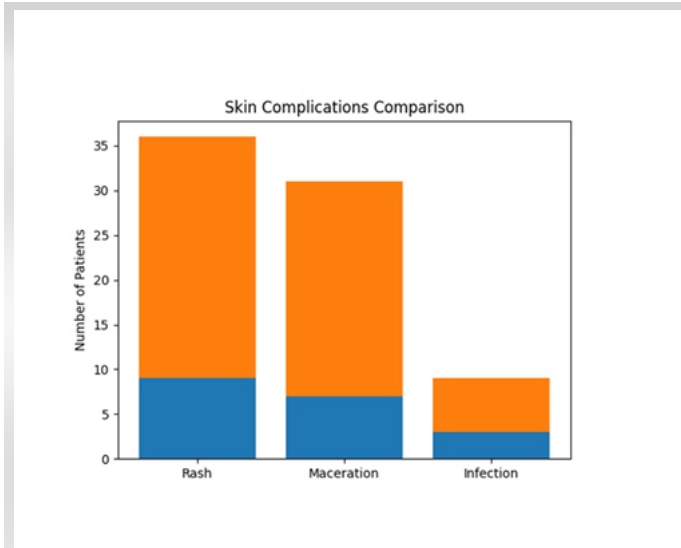


Figure 2: Comparison of Skin Complications

Parameter	Group A	Group B	p-value
<b>Full compliance</b>	214 (95.1%)	189 (84.0%)	0.006
<b>Early removal attempts</b>	7 (3.1%)	25 (11.1%)	0.003

Table 4: Patient Compliance Comparison

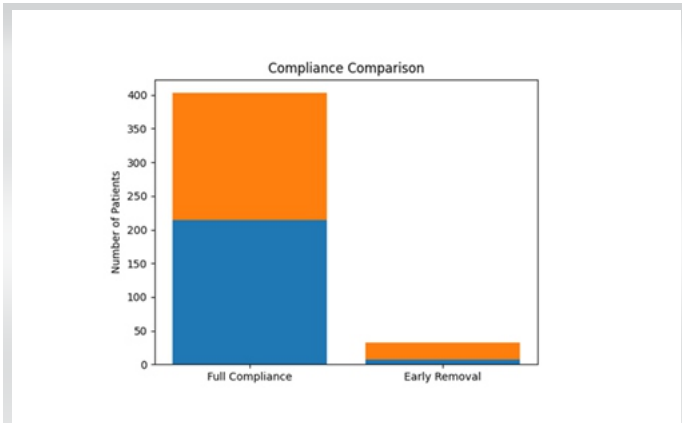


Figure 3: Patient Compliance Comparison

Parameter	Group A	Group B	p-value
<b>Union Rate</b>	219 (97.3%)	215 (95.6%)	0.48

Table 5: Comparison of Fracture Union Rates

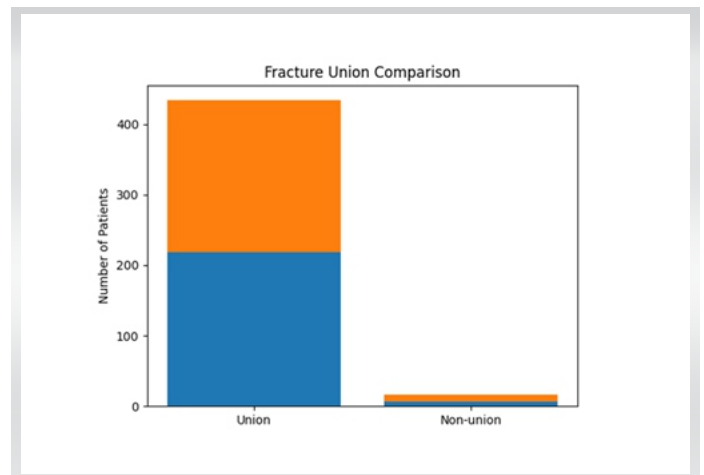


Figure 4: Fracture Union Comparison

removal attempts in the breathable mesh cast group.

**Fracture Union**

Fracture union rates were comparable between the two groups, indicating that the breathable mesh cast does not compromise immobilization effectiveness. The results are presented in Table 5 and illustrated in Figure 4

The figure demonstrates similar union outcomes between both groups, confirming equivalent clinical effectiveness.

Figure 5 demonstrates the structural and functional differences between the two casting techniques. The conventional fiberglass cast shows a solid, circumferential, and non-ventilated design that restricts airflow and may lead to moisture retention beneath the cast. In contrast, the breathable mesh exhibits an open lattice structure with visible ventilation gaps, allowing improved air circulation, enhanced moisture evaporation, and better overall skin hygiene. The mesh design also appears lighter and less bulky, contributing to improved patient comfort and ease of application.

**Discussion**

This randomized controlled trial demonstrates that breathable mesh casts significantly improve patient comfort and reduce cutaneous complications compared to conventional fiberglass casts. The significantly lower VAS itching scores observed across all time points highlight the importance of ventilation in enhancing patient experience.

The reduced incidence of rash and maceration in the mesh cast group supports the hypothesis that improved airflow and reduced moisture accumulation play a critical role in maintaining skin integrity [5,7]. Traditional fiberglass casts create an occlusive environment that traps sweat and increases sub-cast temperature, predisposing to skin complications [4].

Improved compliance in the mesh cast group can be attributed to reduced discomfort and better hygiene. Patients were less likely to attempt early removal, which is a critical factor in ensuring adequate immobilization and optimal fracture healing.

Importantly, fracture union rates were comparable between the two groups, indicating that the breathable design does not compromise mechanical stability or healing outcomes. This finding aligns with



Figure 5A: Fiberglass Cast Figure 5B: Breathable Mesh Cast  
Figure 5: Comparison of Conventional Fiberglass Cast Versus Breathable Mesh Cast

previous studies demonstrating that cast material properties do not significantly affect union when immobilization is adequate [3].

These findings are particularly relevant in tropical climates, where heat and humidity exacerbate the limitations of conventional casting. Breathable mesh casts may therefore represent a significant advancement in patient-centered orthopaedic care. The design advantages of the breathable mesh cast over conventional fiberglass casting are visually demonstrated in Figure 5, highlighting its ventilated architecture and patient-friendly structure.

### Clinical Implication

The use of breathable mesh casts has significant clinical implications in routine orthopaedic practice. By improving ventilation and reducing moisture accumulation, these casts lead to enhanced patient comfort and overall satisfaction during the period of immobilization. This improvement in comfort translates into better compliance with prescribed immobilization protocols, as patients are less likely to experience discomfort or attempt premature removal of the cast. Additionally, the reduced incidence of cast-related issues such as itching, sweating, and skin irritation decreases the need for unscheduled outpatient visits, thereby improving clinical efficiency. The lower rate of cutaneous complications further supports better skin integrity and reduces the risk of secondary problems. These advantages are particularly relevant in hot and humid climates, where conventional casts are often poorly tolerated, making breathable mesh casts a more suitable and patient-friendly alternative.

### Limitations

This study has several limitations that should be considered while interpreting the findings. It was conducted at a single center, which may limit the generalizability of the results to broader populations and different clinical settings. Patient comfort was assessed subjectively using the Visual Analog Scale (VAS), which may introduce individual variability and reporting bias. Additionally, the follow-up duration was relatively short, restricting the evaluation of long-term outcomes and late-onset complications. Finally, blinding was not feasible due to the

obvious visual and structural differences between the casts, which may have introduced observational bias.

### Conclusion

Breathable mesh casts represent a meaningful advancement in the field of fracture immobilization, offering a clinically effective and patient-centered alternative to conventional fiberglass casts. The findings of this study clearly demonstrate that their ventilated, open-structure design significantly improves patient comfort by reducing common issues such as itching, sweating, and a sense of confinement during the immobilization period. This enhanced comfort directly contributes to better patient compliance, which is a critical determinant of successful fracture management.

In addition to improved patient experience, the notable reduction in skin-related complications such as rash, maceration, and irritation highlights the importance of maintaining a favorable microenvironment beneath the cast. By allowing better air circulation and moisture control, breathable mesh casts help preserve skin integrity and minimize dermatological morbidity, which is often underappreciated but clinically significant.

Importantly, these benefits are achieved without compromising the primary goal of immobilization, as fracture union rates were comparable between the two groups. This indicates that breathable mesh casts provide adequate mechanical stability while simultaneously addressing the limitations associated with traditional casting methods.

From a broader clinical perspective, the adoption of breathable mesh casts has the potential to improve overall treatment outcomes by enhancing patient satisfaction, reducing the need for unplanned clinical visits, and streamlining follow-up care. These advantages are particularly relevant in regions with hot and humid climates, where conventional casts are often poorly tolerated.

In conclusion, incorporating breathable mesh casts into routine orthopaedic practice can lead to a more comfortable, compliant, and complication-free recovery process, making them a valuable addition to modern fracture care.

**Declaration of patient consent :** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

**Conflict of Interest:** None, **Source of Support:** None

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