

Comparative Study between Humby Knife and Shaving Blade Skin Grafts in 100 Patients: A Prospective Randomized Controlled Trial

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Abstract:

Background: Split-thickness skin grafting (STSG) is a cornerstone in reconstructive surgery. The Humby knife and shaving blade are two techniques for harvesting grafts, but their comparative efficacy remains understudied. This trial evaluates outcomes of both methods in 100 patients.

Methods: A single-center RCT (2021–2023) 100 patients dividing 2 groups, having procedure of Humby knife (n=50) and shaving blade (n=50). Primary outcomes included graft take rate and complications; secondary outcomes were operative time, pain scores, and cosmetic results. Statistical analysis used t-tests, chi-square, and multivariate regression.

Results: The Humby knife group had higher graft take rates (94% vs. 82%, $p=0.03$), lower infection rates (4% vs. 14%, $p=0.04$), and superior cosmesis (Humby : 6% vs. Shaving 18% ($p=0.03\%$). Operative time was longer for Humby (28.5 ± 4.1 vs. 18.2 ± 3.8 minutes, $p<0.001$).

Conclusion: The Humby knife offers superior graft survival and cosmetic outcomes despite longer operative time, advocating its use in critical reconstructive cases.

Introduction:

Skin grafting remains a cornerstone in the management of extensive cutaneous defects caused by burns, trauma, chronic ulcers, and oncologic resections. Among grafting techniques, split-thickness skin grafts (STSGs) are widely preferred due to their balance between donor site healing and graft adaptability, making them indispensable in reconstructive surgery⁽¹⁾. The success of STSGs hinges on precise harvesting techniques, which influence graft viability, donor site morbidity, and aesthetic outcomes. While mechanical dermatomes like the Humby knife are lauded for their precision, sterile shaving blades have emerged as a pragmatic alternative in resource-limited settings. Despite their

widespread use, comparative data on these methods remain sparse, underscoring the need for evidence-based guidelines to optimize clinical outcomes².

The Humby knife, a calibrated manual dermatome, enables surgeons to harvest STSGs of consistent thickness (0.1–0.4 mm) through an adjustable depth gauge, minimizing donor site trauma³. Its reliability in producing uniform grafts has cemented its role in high-resource environments, particularly for burns and complex reconstructions. Conversely, sterile shaving blades—cost-effective, disposable, and accessible—are frequently employed in low- and middle-income countries (LMICs) where advanced dermatomes are unavailable⁴. However, concerns persist regarding their ability to maintain graft

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uniformity, with studies suggesting variable outcomes depending on operator skill⁵. This dichotomy highlights a critical gap in surgical practice: the lack of standardized comparisons between these tools in similar clinical cohorts.

Existing literature offers fragmented insights. A 2020 randomized trial by Brown et al. reported 94% graft viability with the Humby knife in burn patients, attributing success to its controlled depth mechanism. In contrast, Patel et al. (2021) demonstrated 89% viability using shaving blades in diabetic ulcers, albeit with higher donor site complications⁶. Such disparities in study populations and endpoints hinder direct comparisons, leaving surgeons without consensus on tool selection. Furthermore, donor site morbidity – a key determinant of patient recovery – remains understudied in this context. Excessive dermal injury from irregular harvesting can prolong healing, increase infection risks, and exacerbate scarring, emphasizing the need for rigorous technique evaluation⁷.

This study addresses these gaps by comparing Humby knife and shaving blade techniques in 100 patients requiring STSGs for diverse etiologies. Primary objectives include assessing intraoperative efficiency (harvest time, graft thickness uniformity), postoperative outcomes (graft take rates, complications), and donor site morbidity (healing duration, scarring). Secondary analyses evaluate cost-effectiveness and patient satisfaction, offering a holistic view of each method's strengths and limitations.

The rationale for this investigation extends beyond technical comparison. Global disparities in surgical resources necessitate adaptable solutions: while high-income settings prioritize precision, LMICs often prioritize accessibility⁸. Demonstrating the non-inferiority of shaving blades could expand access to life-saving care without compromising outcomes. Conversely, quantifying the Humby knife's advantages in reducing morbidity may justify investments in surgical infrastructure. Additionally, this study aligns with the World Health Organization's mandate to promote equitable surgical care through context-appropriate innovations⁹.

In conclusion, this comparative analysis bridges a critical evidence gap, offering actionable insights for

surgeons navigating diverse healthcare landscapes. By elucidating the trade-offs between precision and accessibility, it informs guidelines that harmonize clinical efficacy with resource realities, ultimately advancing equitable reconstructive care worldwide.

Materials and Methods:

Study Design

- Type: Prospective, single-blinded RCT
- Setting: 250 Bedded General Hospital, Pabna, Bangladesh (January 2021–December 2023).

Participants

- Inclusion: Adults (18–70 years) requiring STSG for burns, trauma, or post-cancer excision.
- Exclusion: Immunocompromised status, diabetes mellitus, or active infection.

Randomization

- Computer-generated block randomization (1:1 allocation).
- Group A: Humby knife (n=50).
- Group B: Shaving blade (n=50).

Interventions

- Humby Knife: Graft harvested at 0.3 mm thickness using a standardized technique.
- Shaving Blade: Freehand harvesting with a Goulian blade.
- Both groups received identical donor-site dressings (alginate) and postoperative care.

Outcomes

- Primary:
 1. Graft take rate at 7 days (percentage of viable graft).
 2. Complications (infection, hematoma, graft necrosis).
- Secondary:
 1. Operative time (minutes).
 2. Pain scores (Visual Analog Scale, VAS 0–10).
 3. Cosmetic outcome (VAS by blinded plastic surgeon at 6 months).

Statistical Analysis

- SPSS v27.0; t-tests for continuous variables, chi-square/Fisher's exact test for categorical data.
- Multivariate logistic regression for confounders (age, BMI).

- Power: 80% power ($\alpha=0.05$) to detect a 15% difference in graft take rates.

Results

Baseline Characteristics

Groups were comparable in age (Humby: 45 ± 12 vs. Shaving: 48 ± 14), BMI (25 ± 3 vs. 26 ± 4), and defect etiology (burns: 60% vs. 58%).

Primary Outcomes

1. Graft Take Rate:

- Humby: 94% (47/50) vs. Shaving: 82% (41/50) ($p=0.03$; OR 3.1, 95% CI 1.1–8.7).

2. Complications:

- Infection: 4% (2/50) vs. 14% (7/50) ($p=0.04$).
- Partial necrosis: 6% (3/50) vs. 12% (6/50) ($p=0.18$).

Secondary Outcomes

1. Operative Time:

- Humby: 28.5 ± 4.1 minutes vs. Shaving: 18.2 ± 3.8 minutes ($p<0.001$).

2. Pain Scores:

- Humby: 3.2 ± 1.1 vs. Shaving: 4.5 ± 1.3 ($p=0.002$).

3. Donor site Epithelialization:

- Humby: 10.2 ± 2.1 vs. Shaving: 14.5 ± 3.6 ($p<0.01$).

4. Cosmesis (Hypertrophic scar):

- Humby : 6% vs. Shaving 18% ($p=0.03\%$)

Multivariate Analysis

Humby knife independently predicted graft success (adjusted OR 2.9, 95% CI 1.2–7.0).

Discussion:

This prospective randomized controlled trial compared the efficacy, safety, and cosmetic outcomes of split-thickness skin grafts (STSGs) harvested using the Humby knife versus conventional shaving blades in 100 patients. The results demonstrated significant advantages for the Humby knife in graft take rates, infection rates, and cosmesis, albeit with longer operative times. These findings align with existing literature on precision in graft harvesting and underscore the trade-offs between technical complexity and clinical outcomes.

Summary of Key Findings:

1. **Graft Take Rate:** The Humby knife group achieved a significantly higher mean graft take rate (94%) compared to the manual shaving blade

group (82%) ($p=0.03$). This 12% absolute difference represents a clinically substantial improvement in graft survival.

2. **Infection Rate:** Postoperative graft site infection rates were markedly lower in the Humby group (4%) than in the shaving blade group (14%) ($p=0.04$).
3. **Cosmesis:** Assessment of long-term cosmetic outcomes revealed superior results with the Humby knife, with only 6% rated as poor compared to 18% in the shaving blade group ($p=0.03$).
4. **Operative Time:** The primary trade-off identified was operative time. Harvesting with the Humby knife took significantly longer (28.5 ± 4.1 minutes) than with the manual shaving blade (18.2 ± 3.8 minutes) ($p<0.001$).

Interpretation and Contextualization:

1. Superior Graft Take with the Humby Knife:

The significantly higher graft take rate observed with the Humby knife is the most compelling finding. Successful graft “take” relies on rapid revascularization, which is critically dependent on the quality and viability of the grafted tissue and the condition of the recipient bed. The Humby knife, with its adjustable guard and calibrated blade, allows for precise control over graft thickness and uniformity. This contrasts sharply with the manual shaving blade, where thickness is entirely dependent on the surgeon’s skill, hand stability, and pressure, leading to inherent variability. **Inconsistent graft thickness is a well-documented risk factor for graft failure.** Grafts that are too thin are fragile and prone to desiccation or necrosis, while excessively thick grafts may have impaired plasmatic imbibition and capillary inosculation due to a higher metabolic demand and greater distance for vascular ingrowth^{10,11}. The uniformity provided by the Humby likely minimizes areas of critically thin or irregular graft, ensuring a more robust sheet of viable dermis capable of surviving the initial ischemic phase and integrating effectively. This finding aligns with the principle that technical precision directly translates to improved biological outcomes in grafting¹².

2. Reduced Infection Risk :

The nearly 3.5-fold lower infection rate in the Humby group (4% vs. 14%) is highly significant

and likely multifactorial. Firstly, the more uniform, predictable graft thickness achieved with the Humby knife minimizes trauma to the donor site dermis. Excessive depth or irregular harvesting with a manual blade creates a more irregular wound bed with deeper dermal injuries and potentially exposed adnexal structures, increasing the surface area and vulnerability to bacterial colonization and invasive infection^{13,14}. Secondly, the guarded design of the Humby knife may offer a marginal mechanical advantage in preventing direct contamination compared to a completely exposed blade, although strict aseptic technique is paramount in both methods. The cleaner, more controlled donor site wound created by the Humby knife likely heals faster with less inflammation, creating a less hospitable environment for pathogens¹⁵. This reduction in donor site morbidity directly contributes to lower overall infection burden, which can also impact graft survival indirectly.

3. Enhanced Cosmetic Outcomes:

The superior long-term cosmesis observed with the Humby knife donor sites is a crucial patient-centered outcome. Poor cosmesis (hypertrophic scarring, dyspigmentation, contour irregularities) primarily stems from aberrant healing at the donor site, often triggered by excessive depth of harvest or irregular injury patterns damaging the reticular dermis^{16,17}. As established, the Humby knife provides superior control over depth and uniformity. By consistently harvesting within the optimal split-thickness range (avoiding deep dermal injury) and creating a smoother wound bed, the regenerative healing process is favored over reparative (scar-forming) healing⁷. The manual shaving blade, prone to creating uneven depths and focal areas of deeper injury, disrupts the dermal architecture more severely, leading to a higher incidence of hypertrophic scarring and pigmentary changes, reflected in the significantly higher rate of poor cosmesis (18% vs 6%).

4. Operative Time Trade-off:

The significantly longer operative time for the Humby knife (mean difference ~10 minutes) is an undeniable practical consideration. This difference arises from the setup (attaching and calibrating the guard) and the inherent nature of the instrument. The guarded blade requires careful positioning and a controlled, steady

motion for optimal graft harvest. The manual shaving blade, while less controlled, is undeniably quicker to deploy and maneuver. **However, the clinical significance of this time difference must be weighed against the substantial benefits.** Ten extra minutes in the context of most reconstructive procedures involving skin grafting is often marginal. Furthermore, this time represents an investment yielding significantly better graft survival, lower infection rates, and improved long-term appearance – outcomes that directly impact patient morbidity, potential need for regrafting, overall cost of care, and patient satisfaction. Efficiency with the Humby knife also improves with surgeon experience¹⁸.

Strengths and Limitations:

İ% **Strengths:** The prospective randomized controlled design minimizes selection bias and provides the highest level of evidence for comparing these techniques. The relatively large sample size (n=100 patients) provides adequate power to detect clinically meaningful differences in key outcomes. Standardized protocols for harvesting technique, postoperative care, and outcome assessment enhance internal validity.

İ% **Limitations:** The study was conducted at a single center, potentially limiting generalizability. Assessment of cosmesis, while performed by independent assessors blinded to the harvesting method, remains inherently subjective, despite the use of a defined scale; more objective measures (e.g., scar elasticity meters, spectrophotometry) could be incorporated in future studies. The study focused on immediate and medium-term outcomes; longer-term follow-up (>1 year) for scar maturation and patient satisfaction surveys would add further depth. The specific indications for grafting and recipient site locations, while likely similar between groups due to randomization, were not stratified in the analysis. Cost analysis (instrument cost, blade cost, operative time cost) was not performed but is a relevant factor for resource-constrained settings.

Clinical Implications and Conclusions:

This study provides strong evidence that the Humby knife offers significant advantages over the traditional manual shaving blade for STSG harvesting. The

Humby knife demonstrably improves the biological success of grafting through higher take rates, reduces complications via lower infection rates, and enhances the long-term aesthetic result at the donor site. While it requires a longer operative time (approximately 10 minutes), this trade-off appears clinically justified given the magnitude of the benefits in terms of graft survival, reduced morbidity, and superior cosmesis.

The findings strongly support the use of the Humby knife as the preferred instrument for STSG harvesting in settings where it is available and where optimal graft outcomes and donor site appearance are priorities. Its precision and consistency translate directly into tangible patient benefits. The manual shaving blade, while faster and potentially more accessible in very resource-limited settings, carries a significantly higher risk of graft failure, infection, and poor cosmetic results.

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