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From Human Body Curvature to Flat Pattern: A Tape-Mold Transformation Method for Female Corset Form Design

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Abstract: As a highly fitted garment type that integrates structural support, anatomical fit, and aesthetic form, the female corset has historically relied on empirical judgment, traditional draping techniques, and repeated physical sampling during its construction. These conventional approaches often lead to significant difficulties in the accurate extraction of complex human body curvature information and its subsequent transformation into precise two-dimensional flat patterns. In response to these technical challenges, this study proposes an innovative tape-mold-based transformation method tailored for female corset form design, systematically investigating how intricate human body curvature information can be effectively translated into functional flat patterns. Taking the female upper body as the primary anatomical object, the research establishes a rigorous workflow encompassing key-line marking, protective plastic-film wrapping, precise masking-tape application, strategic division-line drawing, piece labeling, mold separation, flat-pattern drafting, and final toile construction. The experimental results conclusively demonstrate that the proposed tape-mold method effectively preserves the essential curvature information of critical areas, including the bust, side bust, waist, and overall torso. Moreover, it significantly improves the intuitiveness and accuracy of division-line judgment, providing a highly operable path for transforming three-dimensional human body curvature into two-dimensional flat patterns. Ultimately, this method offers a valuable technical reference for advanced female corset research, the preliminary development of highly fitted ergonomic garments, and innovative fashion design education. Future work should further enhance the method's standardization and reproducibility through the seamless integration of advanced three-dimensional digital scanning technologies.

Keywords: body curvature; corset design; pattern drafting; garment construction; apparel engineering

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1. Introduction

The female corset is a quintessential example of a highly fitted garment that serves multiple functions, including covering, support, and shaping, particularly in bridal wear, stage costumes, and ceremonial attire. Unlike ordinary womenswear, corsetry demands a more precise conformity to the body's curved surfaces, such as the bust, waist, and torso [1, 2]. The construction of a corset involves intricate processes like bust-volume distribution, curved-surface manipulation, the organization of division lines, and the establishment of local support relationships. These elements collectively contribute to the complexity of pattern generation and form control. Traditionally, the construction of female corsets has relied on techniques such as flat patternmaking and draping. Flat patternmaking offers a standardized approach but often requires multiple adjustments to accommodate complex curvatures. Draping, on the other hand, is more responsive to the body's form but heavily depends on the skill and experience of the operator. A critical challenge in corsetry is transforming the body's curvature information into flat patterns that can be sewn and verified. The tape-mold method addresses this challenge by creating a removable shell on the body surface, which allows for the drawing of reference and division lines. This method facilitates piece separation, flattening, and pattern generation. In this context, the paper explores the significance of the tape-mold method in acquiring form, segmenting structures, and transforming them into planar designs, aiming to bridge the gap between curvature and pattern in the development of highly fitted garments.

2. Related Research and Theoretical Background:

The female corset is a structural garment that is intricately designed based on the body's local curvature. Its design transcends the mere act of covering the bust; it involves the meticulous organization and shaping of the upper body's contour. Unlike ordinary tops, corsetry must achieve a delicate balance of bust accommodation, waist suppression, and silhouette control within a limited structural framework. This complexity necessitates the use of multi-piece assembly, division-line organization, and boundary control [3, 4]. Research indicates that the essence of corset design lies not in the drafting of individual pieces but in the collaborative organization of multiple structural units. These units work together to manage spatial capacity, provide support, and define the visual contour of the garment.

From a structural design perspective, the creation of garment patterns involves transforming three-dimensional forms into two-dimensional representations. For garments like female corsets, which require a high degree of fit, the intricate body curvature poses a challenge. Flat patterns cannot be derived solely through abstract dimensional deduction. Therefore, the transition from body curvature to flat pattern is a complex process that involves structural translation, segmentation, judgment, and correction. This process is not merely about flattening but requires a nuanced understanding of the body's form and the garment's structural needs [5].

The tape-mold method is instrumental in establishing a drawable, separable, and unfoldable shell on the body surface, making curvature information both visible and tangible. Its value lies in its ability to directly record body-surface contours, enabling division judgments in a three-dimensional state and providing a foundational basis for subsequent planar transformation. Despite being a manual technique, the tape-mold method shares logical connections with digital garment development, such as three-dimensional body modeling, interactive digital patternmaking, and virtual fitting. This paper positions the tape-mold method as an intermediary technique that bridges the body, form, and pattern, emphasizing its significance in the transformation of female corset forms. By recording body-surface contours and facilitating structural segmentation and planar unfolding, the tape-mold method offers a valuable approach to understanding and developing highly fitted garments.

3. Research Method

3.1. Research Design

This study integrates practice-based research with process analysis to address the challenge of transforming the curvature of the human body into flat patterns for constructing female corsets. Instead of developing a comprehensive standard corset block system, the research emphasizes the validation of the tape-mold method as a viable approach for initial form acquisition and pattern transformation. The research methodology is structured into four distinct stages. The first stage involves the acquisition of body-surface information, which is crucial for understanding the unique contours and dimensions of the human form. The second stage, structural segmentation, focuses on dividing the body into manageable sections that can be individually analyzed and manipulated. The third stage, pattern-piece flattening, involves translating the three-dimensional body segments into two-dimensional patterns that can be used for garment construction. Finally, the fourth stage, toile validation, serves as a practical test of the patterns by creating a prototype garment to ensure accuracy and fit. This comprehensive approach ensures that each stage of the process is meticulously executed, thereby enhancing the reliability and applicability of the tape-mold method in corset design (As shown in Figure 1).

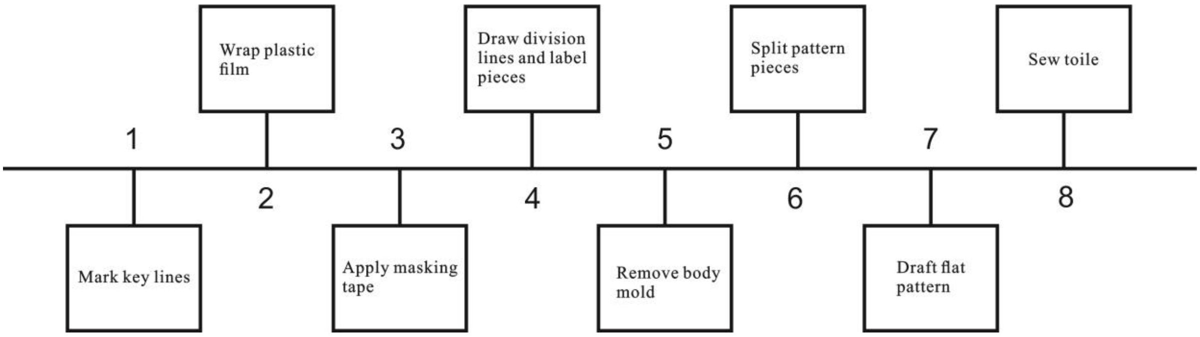


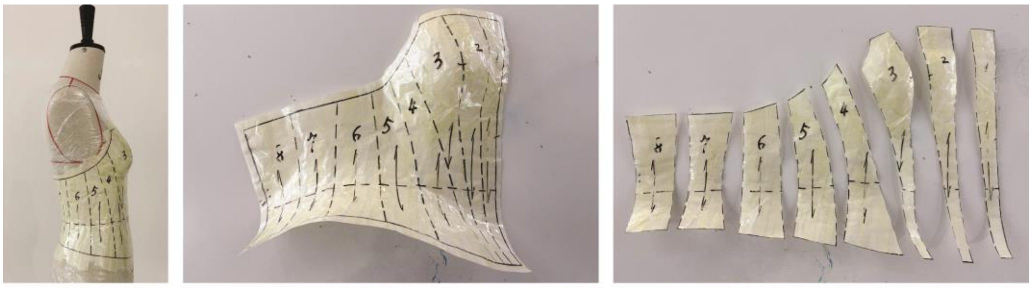
Figure 1. Research Workflow of the tape-mold method.

3.2. Research Object and Materials

The focus of this research was on the corset-related areas of the female upper body, specifically targeting regions such as the bust, side bust, underarm, waist, and back. To ensure the precision of the data collected, the subject was instructed to maintain a natural standing posture, avoiding any excessive twisting, raising of the shoulders, or hunching [4, 6]. This careful positioning was crucial to obtaining accurate measurements and observations. The materials utilized in this study were diverse and included plastic film, masking tape, markers, scissors, patternmaking tools, and toile fabric. These materials were chosen for their effectiveness in capturing the intricate details of the body's contours and facilitating the creation of accurate patterns. The study employed a demonstrative case-based approach, which was primarily aimed at verifying the feasibility and effectiveness of the tape-mold method in acquiring corset forms and transforming these into patterns. This approach was selected over large-sample statistical analysis to focus on the detailed examination of the method's applicability and potential benefits. By concentrating on a case-based methodology, the research was able to delve deeply into the nuances of the tape-mold technique, providing valuable insights into its practical applications in corset design and patternmaking.

3.3. Procedure

The procedure involved several meticulous steps, each contributing to the overall construction and validation of the toile. Initially, key reference lines were established on the female upper body. These lines included the center front, center back, bust line, waistline, and side seam. These lines served as the foundational guide for subsequent steps. Following this, a body mold was created using plastic film and masking tape. This mold was essential for capturing the precise contours and dimensions of the body, ensuring that the final garment would fit accurately. On the surface of this mold, corset division lines and piece labels were carefully marked. These markings were crucial for the later stages of pattern piece separation and organization. Once the mold was fully prepared, it was carefully removed from the body. The removal process required precision to maintain the integrity of the mold and the accuracy of the markings. The mold was then separated along the pre-marked division lines. This separation allowed for the organization of the mold into flat pattern pieces, which are essential for the drafting process. These flat pattern pieces were then used to construct a toile. The toile serves as a prototype garment, allowing for the validation of the pattern and fit before final production. This comprehensive procedure ensures that the final garment is both aesthetically pleasing and functionally effective (As shown in Figure 2).



(a) Body mold line marking (b) Overall body mold shape (c) Body mold piece separation

Figure 2. Formation of the Paper Tape Toile and Pattern Piece Decomposition Process.

4. Results and Analysis

4.1. Body Mold Formation and Preservation of Human Body Curvature Information

The findings of this study demonstrate that the use of plastic film and masking tape to create a shell can effectively cover areas associated with corsets, such as the bust, under-bust, side bust, back, and upper waist. This method successfully preserves the undulations and curvature characteristics of the female upper body. Unlike methods that rely solely on dimensional data or visual observation, the body mold captures the spatial information originally present on the body surface, transforming it into a tangible object. This allows for a more direct visualization of the transitions among bust projection, waist contraction, and the front-to-back relationships. Further examination reveals that the transitional areas from the bust to the side bust and from the under-bust to the waist exhibit distinct spatial turning traces on the mold surface. This suggests that the tape-mold method is capable of recording essential body-surface information necessary for corset form research. It provides a foundational basis for subsequent processes such as division-line setting, piece separation, and pattern organization. By capturing these intricate details, the method enhances the accuracy and effectiveness of corset design, ensuring that the final product aligns closely with the natural contours of the body. This approach not only aids in the preservation of body curvature information but also facilitates a deeper understanding of the spatial dynamics involved in corset construction, thereby contributing significantly to the field of garment design and research.

4.2. Division-Line Expression and Pattern Piece Separation Results

After the body mold was formed, reference lines and division lines were established on its surface, transforming it from a simple body-surface copy into a form medium with structural logic. These basic lines, such as the center front, side seam, and waistline, provided essential positional references. The corset division lines further linked body-surface information with design intention, creating a cohesive framework for the garment's construction. The results demonstrated that the division lines exhibited strong intuitiveness on the mold surface. This allowed the designer to directly assess line direction, piece boundaries, and local volume allocation based on the actual body surface. Consequently, the structural organization of the corset could be preliminarily presented in a three-dimensional state, offering a tangible representation of the design's spatial dynamics. This process not only facilitated the visualization of the garment's structure but also enhanced the designer's ability to make informed decisions regarding the allocation of material and the overall aesthetic of the corset.

Once the mold was removed and separated along the established division lines, the resulting pieces displayed obvious bending, bulging, or twisting. This non-planar condition is a direct reflection of the true curvature characteristics of the human body surface, serving as an important basis for subsequent planar transformation. For instance, pieces in the bust region typically carried larger spatial capacity, accommodating the natural contours of the body. Meanwhile, the side-bust and underarm regions exhibited more complex turning relationships, indicative of the intricate interplay of curves in these areas. Pieces near the waist showed a stronger tendency toward contraction, reflecting the body's natural tapering. Through this meticulous separation process, the continuous body surface was transformed into relatively independent structural units. This transformation made the spatial characteristics of different regions clearer, allowing for a more precise and tailored approach to garment construction. By understanding these spatial dynamics, designers can create garments that not only fit well but also enhance the natural form of the body, achieving both comfort and aesthetic appeal.

4.3. Flat Pattern Formation and Toile Validation Results

After organizing and drafting, the separated body-mold pieces were transformed into preliminary flat patterns. The results revealed distinct differences among these pieces during the planarization process. Some pieces could be flattened relatively naturally, maintaining stable boundaries. However, others, due to their larger original curvature, exhibited spreading or twisting. These required boundary correction and structural adjustments before they could be transformed into workable patterns. This finding indicates that the flat pattern is not merely a mechanical copy of the three-dimensional mold. Instead, it represents a structural reorganization that retains the principal body-surface information. In essence, the transformation from human body curvature to a flat pattern is a continuous translation process involving "curvature information--structural unit--planar reconstruction." This process underscores the complexity and intricacy involved in converting three-dimensional forms into two-dimensional patterns, highlighting the importance of understanding the underlying structural dynamics.

Once the obtained patterns were utilized to construct a toile, the three-dimensional restoration effect could be further examined. When the mold recording was precise, the division lines were appropriately set, and the patterns were properly organized, the toile was able to restore, to a certain extent, the spatial accommodation of the bust, the transition of the side bust, and the contraction at the waist. From a verification standpoint, the toile completed a methodological loop: transitioning from body to mold, from mold to pieces, from pieces to pattern, and finally from pattern back to a three-dimensional form. This cycle confirms the feasibility and effectiveness of the tape-mold method. The formation of flat patterns and the toile restoration results are illustrated in Figure 3. This methodological loop not only validates the approach but also emphasizes the importance of precision and accuracy in each step of the process. The ability to restore three-dimensional forms from flat patterns is crucial in various applications, including fashion design and garment manufacturing, where accurate pattern making is essential for achieving the desired fit and aesthetic [7, 8].

(a) Flat pattern development

(b) Toile construction and restoration effect

Figure 3. Flat Pattern Formation and Toile Validation Using the Tape-Mold Method

4.4. Comparative and Integrated Analysis of Methods

To further elucidate the applicability of the tape-mold method in the construction of corset forms, this study undertakes a comprehensive comparison with traditional flat patternmaking and traditional draping techniques. The analysis reveals that traditional flat patternmaking excels in terms of standardization and is highly suitable for industrial production processes. However, it falls short in effectively capturing the intricate curvatures of the human body. On the other hand, traditional draping is adept at managing three-dimensional spatial relationships, offering a more intuitive approach to garment construction. Nevertheless, it demands a high level of expertise and spatial awareness from the practitioner, which can be a limiting factor for those less experienced. The tape-mold method emerges as a hybrid approach, effectively bridging the gap between these two traditional methods. It allows for the relatively straightforward acquisition of human body curvature information, while also providing a transitional pathway towards the generation of flat patterns. This makes it particularly advantageous for early-stage exploration of corset forms, structural analysis, and educational purposes. By integrating the strengths of both traditional methods, the tape-mold method offers a more versatile and accessible approach to corset construction, particularly in contexts where a detailed understanding of body contours is essential. The comparative analysis is succinctly summarized in Table 1, highlighting the unique benefits and limitations of each method.

Table 1. Comparison between the tape-mold method and traditional corset construction methods

Dimension	**Traditional flat patternmaking**	**Traditional draping**	**Tape-mold method**
Body-surface information acquisition	Relies on dimensions and block deduction	Direct observation of three-dimensional form	Direct recording of the body surface
Curvature intuitiveness	Weak	Strong	Strong
Dependence on experience	High	Very high	Moderate
Pattern-generation path	Two-dimensional deduction to pattern	Three-dimensional shaping followed by pattern conversion	Pattern generation after mold separation
Applicable stage	Standardized development	Three-dimensional form exploration	Early-stage form analysis and transformation
Main limitation	Insufficient curvature expression	Strong dependence on experience	Limited precision and standardization

As illustrated in Table 1, the tape-mold method demonstrates distinct advantages in several key areas. It excels in preserving the intricate details of human body curvature, which is crucial for achieving a precise fit in corset construction. Additionally, it facilitates the visualization of the structural origins of the garment, providing valuable insights during the design process. This method is particularly beneficial for early-stage form exploration, allowing designers to experiment with different shapes and structures before committing to a final design. Despite these advantages, the tape-mold method does face challenges in terms of standardization and industrial applicability. While it offers a more intuitive approach to capturing body contours, further refinement is needed to enhance its compatibility with large-scale production processes. This ongoing development is essential to fully realize the potential of the tape-mold method as a versatile tool in both educational and professional settings. By addressing these challenges, the method could become a cornerstone in the evolution of corset construction techniques, offering a balanced approach that combines the precision of traditional methods with the flexibility of modern innovations.

5. Discussion

The findings of this study indicate that the tape-mold method offers a novel approach to observing and transforming the form of female corsets, aligning more closely with the body's natural morphology. Unlike traditional flat patternmaking, which primarily relies on dimensional deduction, and conventional draping, which heavily depends on the operator's experience, the tape-mold method introduces a drawable, separable, and unfoldable intermediate shell. This innovation transforms the creation of corset structures from an implicit technical skill into a process that is both observable and analyzable. The method's value is not only in its intuitive recording of human body curvature but also in establishing a clearer intermediate layer among the body, structure, and pattern. This enhances the visibility of early-stage form analysis and structural transformation in corset design. For garments such as female corsets, bridal corsets, and other highly fitted apparel, this method holds significant potential in preliminary development. Additionally, it shows promise for design education and subsequent digital modeling [9, 10]. By providing a more tangible and visual approach to corset design, the tape-mold method could revolutionize how designers approach the creation of fitted garments, offering a more precise and adaptable framework for both educational and practical applications.

Despite its advantages, the study also highlights certain limitations of the tape-mold method [11, 12]. It remains influenced by factors such as manual accuracy, material stability, and flattening error, which means it cannot yet fully replace standardized industrial pattern systems [13]. Particularly in areas of high curvature, the planarization of pattern pieces still relies on structural judgment and empirical correction, making the results partially dependent on the operator's skill [14]. Furthermore, the current study primarily focuses on demonstrating the feasibility of the method rather than exploring large-sample body-type adaptation, industrial grading, or quantitative evaluation [8, 14]. Future research should aim to investigate various corset segmentation modes, accommodate different body types, and explore mechanisms for digital integration [13, 14]. Such efforts would be crucial in enhancing the method's standardization and expanding its applicability across a broader range of contexts [10]. By addressing these areas, the tape-mold method could be refined to offer a more standardized approach, potentially leading to its adoption in industrial settings and further integration into digital design processes [12, 14]. This would not only improve the precision and efficiency of corset design but also broaden its applicability to a wider array of garment types and body shapes [2].

6. Conclusion

This study has delved into the intricate process of transitioning from the natural curvature of the human body to a flat pattern, with a particular focus on the tape-mold method in the context of female corset design. The research highlights the method's ability to effectively capture and preserve the three-dimensional contours of the female upper body, especially in critical areas such as the bust and waist. By employing reference and division lines, the tape-mold method facilitates the conversion of body-surface information into a structurally significant intermediate system, which is crucial for garment design. This transformation is further enhanced through mold separation, pattern organization, and toile construction, establishing a seamless pathway from the body's natural curves to a flat pattern and back to a three-dimensional form. The method's value is underscored by its contribution to process visualization and structural analysis, making it a valuable tool in the preliminary stages of developing female corsets and other closely fitted garments. Furthermore, the tape-mold method holds significant potential for design education, offering a practical approach to form experimentation and providing a foundation for future digital integration. The implications of this study suggest that further research could explore the adaptation of this method to other garment types and its integration with digital technologies to enhance precision and efficiency in garment design. By expanding the application of the tape-mold method, future studies could contribute to the evolution of garment construction techniques, ultimately leading to more innovative and customized fashion solutions.

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