

A Study on the Formal Evolution of Eastern Zhou Leather Armor and Its Relationship with the Hierarchy System

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APA Citation and Referencing: Liu, Y., Zhou, X., Tan, X. & Li, T. (2026). A Study on the Formal Evolution of Eastern Zhou Leather Armor and Its Relationship with the Hierarchy System. *JENER Journal of Empirical and Non-Empirical Research*, 2(1), 165-170

ARTICLE INFORMATION	ABSTRACT
<p>Article history: Published on 11th January 2026</p> <p>Keywords: Eastern Zhou Leather Armor Formal Evolution Hierarchy System</p>	<p>The Eastern Zhou period was a crucial stage in the development of ancient Chinese armor, during which leather armor, as the primary protective equipment, played a pivotal role in military warfare. Based on archaeological findings and documentary records, this study systematically explores the formal evolution, manufacturing techniques, and relationship with the hierarchy system of Eastern Zhou leather armor. The research indicates that Eastern Zhou leather armor was primarily unearthed from Chu-related tombs, such as the Tomb of Marquis Yi of Zeng and the Juliadun Chu tombs, demonstrating an evolutionary trajectory from monolithic forms to lamellar structures. The production techniques of leather armor had reached a relatively advanced level, employing molding technology, lacquering processes, and ribbon lacing, forming a hierarchical system categorized as "rhinoceros-hide armor in seven layers, wild ox-hide armor in six layers, and laminated armor in five layers." The materials, forms, and decorations of the armor reflected a strict hierarchy, serving as significant symbols of identity and ritual.</p>

1. Introduction

The Eastern Zhou period (770 BCE-256 BCE) was a crucial stage in the development of ancient Chinese armor. Leather armor, as the primary protective equipment, played a key role in military warfare. During the Spring and Autumn and Warring States periods, the rivalry among feudal lords and frequent warfare drove the rapid advancement of armor technology. Leather armor gradually evolved from the monolithic forms of the Shang and Zhou periods to lamellar structures, forming a relatively comprehensive production system and hierarchy.

Archaeological findings indicate that Eastern Zhou leather armor has primarily been unearthed from tombs of the Chu cultural sphere, with the highest concentrations in Hubei, Hunan, and Henan provinces. Among these discoveries, the leather armor from the Tomb of Marquis Yi of Zeng, unearthed in 1978 from Tomb No. 1 at Leigudun, Suizhou, Hubei, represents the most significant physical evidence from the Eastern Zhou period. Over a hundred pieces of leather armor, including both human and horse armor, were discovered in the northern chamber of the tomb. After restoration and sorting, 13 relatively complete sets of human armor and 2 incomplete sets of horse armor were identified. These leather armors were crafted using lacquer techniques, with plates mostly rectangular or irregular in shape, featuring multiple perforations along the edges. Most were coated with black lacquer, while a minority were coated with red lacquer. Additionally, 30 pieces of leather armor were unearthed from Tomb No. 1 at Juliadun in Zaoyang, Hubei, and fragments of leather armor were also found in sites such as Tomb No. 1 at Tianxingguan, Jiangling, Hubei, and the Warring States tomb at Zuoqia Gongshan in Changsha. These archaeological discoveries provide valuable material evidence for studying the formal evolution and hierarchical system of Eastern Zhou leather armor.

2. Literature Review

2.1 Overview of Archaeological Discoveries

Archaeological discoveries of Eastern Zhou leather armor are primarily concentrated in the Chu cultural region. Tomb M1 and M86 at Caomenwan in Zaoyang have yielded a significant quantity of leather human and horse armor, dating approximately to the early Spring and Autumn period. These represent the earliest known examples of laced leather armor and provide crucial physical evidence for studying the forms of early Eastern Zhou leather armor. The leather armor unearthed from the Tomb of Marquis Yi

of Zeng in Suixian County is the most representative material from this period. Over a hundred pieces of leather armor, including both human and horse armor, were discovered in the northern chamber of the tomb. After sorting and restoration, 13 relatively complete sets of human armor and 2 incomplete sets of horse armor were identified. Tomb No. 1 at Jiuliandun in Zaoyang yielded 30 pieces of leather armor, while Tomb M2 at Baoshan in Jingmen produced 2 sets each of human and horse armor. Additionally, leather armor or scattered armor fragments have been excavated from sites such as Tomb M1 at Tianxingguan in Jiangling, Tomb M1 at Wangshan, Tomb M1 at Tengdian, and Tomb M5 at Paishan. Other discoveries include leather armor remains from the Spring and Autumn to Warring States periods at sites such as Tomb M1 at Angang Chu Tomb in Laohekou, Tomb M107 at Tuanshan Cemetery in Xiangyang City, Tomb M2 at Shanwan in Xiangyang, the Zhaojiagang Chu Tomb Cluster in Dangyang County, Yichang, and Tomb M5 at Caojiagang in Dangyang. Five sets of leather armor were unearthed from Chu tombs in Changsha, two of which are well-preserved. One piece of leather armor was found in Tomb M1 at Liuchengqiao in Changsha, while the leather armor from Tomb M15 at Zuoja Gongshan in Changsha exhibits a unique form, with an upper part made of leather stitched from small squares and a lower part made of silk. Scattered leather armor fragments have also been discovered at sites such as Tomb M2 at Niuxingshan in Xiangxiang and Tomb M10 at Xinqiaohe in Yiyang. In Henan, leather armor fragments have been unearthed from Tomb M2 of Group B at the Chu tombs in Xiasi, Xichuan; the Ge Mausoleum Chu Tomb in Xincui; Tomb M1 at Baishizi in Gushi; and the Spring and Autumn period Tomb M1 at Yuehe Town in Tongbai County. These archaeological discoveries provide abundant physical evidence for studying the forms, production techniques, and hierarchical systems of Eastern Zhou leather armor.

2.2 Research Status

Academic research on Eastern Zhou leather armor has established a relatively systematic scholarly framework, primarily focused on foundational areas such as formal classification, production techniques, and functional analysis. Scholars like Bai Rongjin (1978) conducted pioneering systematic restoration studies on the leather armor from the Tomb of Marquis Yi of Zeng, categorizing the armor plates into 23 types and 39 subtypes. This work revealed the complex production techniques of Eastern Zhou leather armor and laid a solid foundation for subsequent research. Wang Xianfu (2016) conducted an in-depth restoration study of the leather armor from Tomb No. 1 at Jiuliandun, distinguishing for the first time between Type A and Type B armor forms. This provided significant insights for understanding the formal evolution of Eastern Zhou leather armor. Scholars such as Yang Hong (1976) and Zhang Weixing (2005) systematically explored the development and evolution of leather armor from a military history perspective, situating it within the broader framework of the development of ancient military equipment. Additionally, many scholars have enriched the study of Eastern Zhou leather armor from various angles. However, existing research remains insufficient in exploring the relationship between leather armor and the hierarchical system, as well as the underlying causes of formal evolution.

3. Formal Styles and Evolutionary Characteristics of Eastern Zhou Leather Armor

3.1 Formal Structure and Classification

Eastern Zhou leather armor developed a relatively comprehensive classification system, which can be divided into two main types based on excavated artifacts.

Type A leather armor, represented by Armor No. 3 from the Tomb of Marquis Yi of Zeng, exhibits a complete four-part structure: helmet, chest armor, armor skirt, and sleeve armor. The helmet is composed of 18 armor plates of varying shapes, with a raised central ridge along the midline to enhance protective strength. The chest armor consists of 20 irregularly shaped plates assembled into a rigid lamellar structure, featuring a basin-shaped collar design that is lower in the front and higher in the back, providing neck protection while allowing ease of head movement. The armor skirt is constructed from four columns of plates, each column containing 14 plates, totaling 56 plates, and is attached using a hanging method to ensure flexibility during movement. The sleeve armor comprises a pair of semi-enclosed cylindrical structures, each formed from 13 columns of plates, with 4 plates per column. This type of armor employs a side-opening design, with the opening located on the right side for ease of wear and removal.

Type B leather armor, represented by the armor unearthed from the western chamber of Tomb No. 1 at Jiuliandun, is generally assembled from small rectangular armor plates. The plates used in various parts of this type are similar in size and shape, resulting in a more uniform overall form. The leather armor excavated from the Warring States period tomb at Zuoja Gongshan in Changsha also belongs to this category. Its upper half is made of leather, while the lower half is crafted from silk material. The leather portion is stitched together from small square pieces, a form that more closely resembles Qin Dynasty armor and laid the foundation for the standardization of armor during the Qin and Han periods.

3.2 Production Techniques and Technological Characteristics

The production techniques of Eastern Zhou leather armor were already quite mature. The *Zhouli·Kaogongji* (Rites of Zhou - Records of Artificers) provides a detailed account of the manufacturing standards for leather armor, stipulating that it must "fit the body, with the weight of the armor top and skirt being comparable, the girth matching the length, the leather being tanned to medium firmness, the armor holes small, the inner surface smooth and clean, seams straight, compact when rolled up, expansive when laid flat, and the plates not interfering with each other when worn."

Armor plate processing employed molding techniques. During restoration, Bai Rongjin observed that the edges of armor plates were commonly reinforced, and horse armor featured raised decorations and mold impressions, suggesting the use of molds in plate processing. Armor No. 3 from the Tomb of Marquis Yi of Zeng utilized a total of 23 types and 39 styles of armor plates, requiring at least 46 sets of molds, indicating a highly complex manufacturing process. The plates were laced together using silk

ribbons dyed vermilion with cinnabar, which corresponds to the historical record in the *Zuozhuan·Xianggong Three Years* (Zuo Commentary, Third Year of Duke Xiang): "three hundred sets of laced armor, three thousand coats of practice armor."

Lacquering was a critical step in leather armor production, serving not only decorative purposes but, more importantly, creating a waterproof layer to prevent the leather from absorbing moisture, swelling, softening, and losing its defensive capabilities. During the Eastern Zhou period, lacquerware production in the Chu region was exceptionally refined, providing the technical foundation for the lacquering of leather armor.

3.3 Trajectory of Formal Evolution

The Eastern Zhou period was a critical stage in the evolution of leather armor from the "monolithic form" of the Shang and Zhou periods to the "lamellar armor" style. The remains of leather armor discovered in the large tomb No. 1004 at Houjiazhuang in the late Shang Dynasty site of Yinxi were made from a single piece of leather. During the Western Zhou period, rectangular armor plates began to appear, but they were still stitched onto a leather backing, with no interlocking connections between the plates. By the Eastern Zhou period, armor plates had fully transitioned to lamellar pieces, and the lacing method shifted away from the stitching technique of monolithic armor, initially forming the lacing pattern characteristic of lamellar armor. This evolution marked a significant advancement in leather armor production technology, transitioning from holistic protection to segmented lacing, which not only improved protective performance but also enhanced mobility.

The formal characteristics of Eastern Zhou leather armor plates exhibit a clear trend from diversification toward standardization. The armor plates unearthed from the Tomb of Marquis Yi of Zeng display a variety of shapes, including elongated strips, trapezoids, sulphonated forms, ox-horn shapes, and curved rectangles, among other irregular forms. These plates required multiple molds for processing, making the craftsmanship complex and difficult to interchange. In contrast, Type B leather armor employed uniformly rectangular plates throughout, resulting in a more standardized form. This trend toward standardization laid the groundwork for the standardization of armor during the Qin and Han dynasties. Standardization not only increased production efficiency but also facilitated rapid replenishment and repairs during wartime, reflecting the direction of military equipment manufacturing toward large-scale and standardized development.

In terms of protective coverage, leather armor during the Eastern Zhou period showed significant expansion compared to the Shang and Zhou periods. For example, Armor No. 3 from the Tomb of Marquis Yi of Zeng measures approximately 84 cm in height from the collar edge to the skirt bottom, with a shoulder width of 48 cm, a chest circumference of 119 cm, sleeve length of 40 cm, and a skirt bottom circumference of 156 cm, effectively protecting the warrior's body from the neck to the knees. This long and heavy armor skirt was suitable for chariot warfare, reflecting the characteristics of the chariot warfare era. The expansion of protective coverage was evident not only in size but also in the refinement of protective areas. The segmented design of the helmet, chest armor, armor skirt, and sleeve armor allowed each part to provide independent protection while coordinating with others to form a complete protective system. This design ensured both protective effectiveness and mobility, representing an important achievement in the formal evolution of Eastern Zhou leather armor.

The formal style of leather armor also exhibits distinct regional characteristics. The Chu cultural region demonstrated the most advanced leather armor production, with examples unearthed from sites such as the Tomb of Marquis Yi of Zeng and the Juliadun Chu tombs representing the highest level of craftsmanship at the time. These leather armors were not only exquisitely crafted but also elaborately decorated, with some plates adorned with gold or silver foil. In contrast, leather armor from other regions tended to be simpler in design and more modest in ornamentation. Such regional differences reflect variations in leather armor production techniques, aesthetic preferences, and military needs across different areas.

4. Hierarchy System of Eastern Zhou Leather Armor

4.1 Differentiation of Material Grades

During the Eastern Zhou period, the selection of materials for leather armor formed a distinct hierarchical system. According to the *Kaogong Ji* (Artificers' Record), leather armor materials were categorized into three grades: rhinoceros-hide armor, wild-ox-hide armor, and laminated armor. Rhinoceros-hide armor, made from rhinoceros hide, had a lifespan of one hundred years. Wild-ox-hide armor, crafted from the hide of wild oxen (generally considered to be wild buffalo or sacred water buffalo), had a lifespan of two hundred years. Laminated armor was produced by shaving the inner layer of leather and laminating multiple layers together, with a lifespan of three hundred years. Leather armor made from different materials exhibited significant differences in protective performance and durability. The *Zuozhuan·Xuanggong Two Years* records a commoner mocking Hua Yuan for discarding his armor, to which Hua Yuan's subordinate retorted, "Oxen have hides, and there are still plenty of rhinoceroses and wild oxen." This indicates an ample supply of armor-making materials, with different grades of materials corresponding to distinct social statuses.

4.2 Form and Decoration as Hierarchical Markers

The form and decoration of Eastern Zhou leather armor also reflected a strict hierarchical system. The armor worn by high-ranking commanders was assembled from various irregularly shaped plates, featuring complex craftsmanship and exquisite decoration. For example, the leather armor unearthed from Chu Tomb No. 5 at Caojiagang in Dangyang, Hubei, was adorned with gold foil, silver foil, and tin-lead alloy foil decorations on the plates, displaying a variety of forms and ornamental patterns that exuded opulence and elegance. In contrast, the armor worn by ordinary soldiers was assembled using simple rectangular plates with modest decoration.

The *Kaogong Ji* also records the lacing specifications for armor of different ranks: "Rhinceros-hide armor has seven layers, wild-ox-hide armor has six layers, and laminated armor has five layers." Here, "layers" refers to the number of overlapping rows of plates. Tougher leather allowed for longer plates, resulting in fewer overlapping rows and stronger protective performance.

4.3 Hierarchical Classification of User Groups

The user groups of Eastern Zhou leather armor were strictly stratified. Archaeological findings indicate that tombs containing lacquered leather armor are predominantly large Chu tombs, with tomb occupants identified as nobles or high-ranking officials. The occupant of the Tomb of Marquis Yi of Zeng was the ruler of the Zeng state during the early Warring States period, while tombs such as Jiuliandun Tomb No. 1 and Tianxingguan Tomb No. 1 also belong to the nobility. This suggests that lacquered leather armor was primarily equipped to chariot warriors, whose status was at the "shi" (士) level or above.

The *Guoyu · Qiyu* (Discourses of the States: Discourses of Qi) records, "For serious crimes, the punishment is redeemable with a set of rhinceros-hide armor and a halberd." Similarly, the Qin bamboo slips from Yunmeng contain numerous legal provisions regarding "贖甲" (redeeming armor), where "贖" denotes punishment. According to *Research on Armor in the Spring and Autumn Period*, a set of leather armor in the Warring States state of Qin was valued at ten thousand coins, while one dou (斗) of rice cost only 160 coins. This indicates that leather armor was a relatively expensive piece of equipment at the time, making it unaffordable for ordinary soldiers.

5. Discussion

5.1 Relationship Between Leather Armor and Ritual Systems

During the Eastern Zhou period, ritual systems served as the core norms of social order and established a comprehensive regulatory framework for the form, materials, decoration, and usage of leather armor. This regulation was not only reflected in the standardization of production techniques but also deeply embodied the patriarchal hierarchy of "rituals distinguishing differences," elevating leather armor beyond mere protective functionality to become an important symbol of identity and status.

The *Zhouli · Kaogong Ji* (Rites of Zhou - Artificers' Record), a significant pre-Qin document on handicraft technology, systematically outlined ritual requirements for leather armor production. The stipulation that "in making armor, one must first create the mold, then prepare the leather" reflects the strict ritual regulation of armor manufacturing. "Mold" here refers to the clay template for shaping armor plates, indicating that all plates adhered to standardized designs. Such standardized production criteria ensured both uniformity and hierarchical differentiation in armor form. Ritual specifications for armor production manifested in multiple aspects: first, "proper fit," requiring the armor to match the wearer's body dimensions; second, "equal weight between the armor top and skirt," emphasizing balance; third, "uniformity in circumference and length," ensuring overall suitability; and further details such as "leather tanned to medium firmness," "small armor holes," "smooth and clean inner layers," "straight seams," "compact when rolled up," "expansive when laid flat," and "plates not interfering when worn." These specifications not only guaranteed the protective performance of leather armor but also demonstrated the rigorous ritual management of military equipment.

Moreover, the material selection for leather armor during the Eastern Zhou period formed a clear hierarchical system. The *Kaogong Ji* records three grades of armor materials: rhinceros-hide armor, wild-ox-hide armor, and laminated armor. Rhinceros-hide armor, made from rhinceros hide, had a lifespan of one hundred years; wild-ox-hide armor, crafted from wild-ox hide (generally interpreted as wild buffalo or sacred water buffalo hide), lasted two hundred years; and laminated armor, produced by shaving the inner flesh layer from leather and laminating multiple layers, endured three hundred years. Armor made from different materials exhibited distinct differences in protective performance and durability, reflecting the concrete manifestation of ritual hierarchy. This graded material system transformed leather armor into a visual marker of identity and status.

The form and decoration of leather armor during this period also adhered to strict hierarchical distinctions. High-ranking commanders wore armor assembled from diverse irregularly shaped plates, featuring intricate craftsmanship and elaborate decorations. For example, the leather armor unearthed from Chu Tomb No. 5 at Caojiagang in Dangyang, Hubei, was adorned with gold foil, silver foil, and tin-lead alloy foil decorations, displaying varied forms and ornamental patterns that exuded opulence and elegance. In contrast, armor for ordinary soldiers consisted of simple rectangular plates with modest decoration. The *Kaogong Ji* also specifies the lacing standards for different armor grades: "rhinceros-hide armor has seven layers, wild-ox-hide armor has six layers, and laminated armor has five layers," where "layers" refers to the number of overlapping rows of plates. Tougher leather allowed for longer plates, resulting in fewer overlapping rows and stronger protective performance. This variation in lacing standards created distinct formal differentiations among armor of different ranks.

Armor was not merely protective gear but also a symbol of identity and status. In military rituals, commanders of different ranks wore armor of varying forms and decorations to signify their identity and authority. Texts such as the *Book of Rites* documented the regulations for armor wear from the Son of Heaven down to the scholar-official class, with strict distinctions in materials, forms, and decorations, embodying the patriarchal principle of "rituals distinguishing differences."

In burial customs, leather armor, primarily found in tombs of high-ranking nobles, likely included equipment used by the deceased during their lifetime, honorific items bestowed upon them, or specially crafted burial objects. The large quantities of leather armor unearthed from grand tombs such as the Tomb of Marquis Yi of Zeng and Jiuliandun Tomb No. 1 not only reflected the military status of the tomb occupants during their lifetimes but also symbolized their identity and power. This burial practice illustrates the ritual regulation of funeral ceremonies and the significant role of leather armor within the social hierarchy. Archaeological findings indicate that tombs containing leather armor are relatively rare, mostly belonging to rulers, feudal lords, or their

accompanying burials. For instance, Tomb No. 1 at Caomenwan yielded at least four sets of horse armor and seven sets of human armor, with plates typically lacquered on both sides, often evenly coated and smoothly finished, some adorned with decorative metal foils. Such high-caliber burial objects suggest the tomb occupant's eminent status, possibly a ruler of the Zeng state or a high-ranking military commander. The craftsmanship and quantity of the leather armor reflected the military achievements and status of the deceased during their lifetime. In contrast, the leather armor remains from Tomb No. 5 at Paishan in Jiangling, Hubei, consisted only of scattered armor plates, with no complete armor tops, helmets, or sleeves found. These plates were uniform in shape, with relatively crude edge treatment and thin lacquer layers, lacking metal inlays or complex patterns. The tomb's scale and specifications were moderate, suggesting its occupant was a mid- to lower-ranking official of Chu. This phenomenon indicates that in tombs of non-high-ranking nobles, buried leather armor was not only scarce but also exhibited significantly simplified craftsmanship and decoration, corresponding to the social status and material resources available to the tomb occupants during their lifetimes.

5.2 Significance of Formal Evolution and the Hierarchy System

The formal evolution of Eastern Zhou leather armor holds a milestone significance in the developmental history of ancient Chinese armor. The transition from the monolithic forms of the Shang and Zhou periods to the lamellar armor style represented not only a major breakthrough in manufacturing technology but also an inevitable outcome of military equipment adapting to changes in warfare forms. This evolutionary process reflects the technological advancement from holistic protection to segmented lacing, allowing leather armor to maintain protective performance while significantly enhancing mobility. The uniform rectangular plates used in Type B leather armor laid the foundation for the standardization of armor during the Qin and Han periods. The lamellar lacing pattern became the primary form of armor in later eras, influencing armor production from the Qin and Han dynasties through the Tang and Song periods. The production techniques of Eastern Zhou leather armor, such as molding technology and lacquering processes, were also inherited and developed by later generations, forming an important technical tradition in the production of ancient Chinese armor.

The hierarchical system of leather armor served as a concrete manifestation of ritual culture within the realm of military equipment. Through strict distinctions in materials, forms, and decorations, it materialized social hierarchy into visible differences in military equipment, providing a reference for later military equipment management systems. It also offered a standardized basis for military management, with leather armor of different grades corresponding to varying usage rights and management standards, thereby forming a differentiated lacing specification system. This system not only regulated the production and use of leather armor but also laid the groundwork for the establishment of an armory system, ensuring centralized storage, unified management, and strict prohibition of private possession. These practices provided important insights for subsequent military equipment management systems.

6. Conclusion

The Eastern Zhou period represents the definitive phase in the evolution of ancient Chinese leather armor from the monolithic forms of the Shang and Zhou dynasties to the lamellar style. This transformation was not merely an adaptive innovation in response to changes in warfare patterns—particularly the shift from chariot-based to infantry- and cavalry-dominated combat—but also marked a fundamental breakthrough in armor manufacturing technology, progressing from holistic protection to modular and standardized assembly.

The form, materials, and decorations of leather armor were deeply integrated into the ritual systems and social hierarchy of the time. The evolution of its form reflects changes in military technology and social institutions, while its hierarchical system demonstrates the strict regulation of military equipment by ritual norms. The interplay between formal evolution and hierarchical structure together constituted a distinctive practice of early Chinese civilization in balancing technological rationality with the construction of social order. This holds irreplaceable academic value for understanding state formation and cultural integration in ancient China.

Funding sources

This study is supported by a limited research grant from the Chongqing Federation of Social Science Associations. The funding project title: Research on the Restoration, Production, and Finite Element Analysis of Protective Performance of Leather Armor in Pre-Qin period, and project number: 2020BS09.

Declaration of authors' conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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