RESEARCH PAPER

Architectural Anatomy of the Dorsal Palmar Fascia: Insights from Hydro-preservation and Layer-by-Layer Non-scalpel Dissection

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Abstract

Background: The practice of dissection of the human body in learning anatomy provides a hands-on experience, transforming theoretical knowledge into three-dimensional understanding and fostering clinical insight and precision. Even though the conventional scalpel dissection has been the sole established method in all these years, there are limitations, which include tissue rigidity, loss of colour and hydration.

Objective: The study aims to demonstrate the novel hydropreservation and layer by layer non-scalpel dissection for delineation of the fascia of the dorsum of the hand. The primary aim was to assess the superiority in preservation of anatomical structures in the dorsum of the hand and separation of individual layers. Also, it aims to evaluate the integrity of tissues in this method.

Method: The author performed layer-by-layer non-scalpel dissection on sixteen fresh cadaveric upper limb specimens. A diary recorded the structures identified throughout the procedures along with the texture consistency and integrity of tissues. Also, the differences noted in the dissection of each specimen were also recorded.

Result: The hydro preserved specimen was soft and loose making the separation of fascia much easier. A thin bilaminar layer of superficial fascia, along with minimal fat, was observed under the dermal layer, which was separable when submerged in the layer-by-layer non-scalpel dissection machine unit. Superficial veins and nerves are observed between the two laminae. The superficial facia is loosely adhered to extensor retinaculum. A tough fibrous oblique band proximal to the Extensor Retinaculum, the deep facia diminishes and merges with 3rd laminar of superficial fascia which is inseparable. All other structures identified were recorded in the diary. The major advantage of hydro preservation and non-scalpel dissection is the use of water as the preservative.

Conclusion: Hydro preservation and dissection method is totally effective in delineating the fascia of dorsum of hand. The toxic effects of formalin could completely be overcomed and the integrity of tissues are completely preserved in this method The daily change of water in the machine also reduces any risk of infection avoiding toxicity with formalin could produce.

Keywords: hand dissection, hydropreservation, non-scalpel dissection, tissue integrity, delineation of fascia.

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Introduction

Dissection of human body to learn anatomy has been practiced Since times of Susruta(1) . Animals who were sacrificed for rituals were earlier used to understand the organisation of structures. Then humans who were killed in wars battles etc were also used for the same. The limitation of this is some parts may be distorted due to injury in battle field. So a complete understanding of human body was missing. Later dead, unclaimed bodies were collected and a technique explained by Acharya Sushruta was used to separate the layers in the body to understand the structures within. (2)The dead body is wrapped using herbs like munja, nyagrodha, ashvatha, udumbara, plaksha, pareesha, kusha and shana. A bamboo cage is used to keep the wrapped body which is immersed in water. Brushes made of ushira, hair, bamboo and balvaja are used to peel off the layers of body to study the structures beneath(3,4).

In later years, with advancement of modern methods the conventional dissection method along with preservation of body in formalin came into being. This has been continued for years till date as no new methods where incorporated or identified. This method though not perfect has drawbacks like drying of body thus difficult to identify or separate layers of skin and chemical adverse effects.(5) Ancient Greeks use theological principles based methods dissection of animals and also humans to study anatomy. Chinese too practised human dissection for anatomical knowledge. In Rome there was prohibition for human dissection so animals were used. The same was followed in Europe through Middle Ages(6). In 16th century human resection returned and situation improved later leading to autopsy based methods during 18th century. By 19th century the advent of microscope based methods and emergence of anatomical sections came into being. By 20th century human observational studies medical imaging and molecular methods were used and 21st century witnessed technology based methods in learning of anatomy.(1,7,8)

Embalming with formalin:

Formalin has been widely used as a standard embalming fluid for centuries due to its effective preservative properties. However, its use is associated with several drawbacks, including toxicity, strong odor, and the tendency to harden tissues, which can hinder detailed anatomical dissection. These limitations have prompted ongoing efforts within the anatomical sciences community to identify alternative embalming solutions that can preserve tissue in a more lifelike state while being less caustic and harmful.(9)

In a comparative study, Villacorta and co – authors evaluated six formalin-embalmed cadavers against Thiel-embalmed cadavers, focusing on parameters such as color, texture, blood vessel integrity, joint flexibility, and the condition of the cadavers after one year. The results indicated that formalin-preserved cadavers exhibited tough and rigid tissues, making dissection more difficult. Differentiating between skin, muscle, and fascia was challenging, particularly in the head and neck regions, where tissues were notably hardened. Nevertheless, viscera and major anatomical landmarks remained identifiable.(10)

Conversely, Thiel-embalmed cadavers demonstrated excellent tissue color, pliability, and flexibility, along with a markedly reduced odor, making them well-suited for musculoskeletal dissections. However, the visceral organs were found to be soft and distensible, requiring delicate handling, and connective tissues were fragile and easily disrupted. Despite these issues, Thiel cadavers were considered highly beneficial for procedural training, particularly for intubation and laparoscopic techniques. The study concluded that while Thiel embalming offers significant advantages in replicating the lifelike qualities of human tissue, it is not yet a complete substitute for formalin embalming in anatomical education, especially for long-term structural preservation and clarity(11).

Moreover, the International Agency for Research on Cancer (IARC), in its June 2004 report, classified formaldehyde as a Group 1 carcinogen, indicating sufficient evidence of its carcinogenicity in humans. Prolonged exposure to formaldehyde has been associated with an increased risk of developing nasopharyngeal carcinoma, leukemia, and carcinomas of the paranasal sinuses. Despite these risks, it has been emphasized that the adverse effects are concentration-dependent(12,13). Consequently, several studies have recommended the use of low-concentration formalin embalming techniques to reduce health hazards while still achieving effective tissue preservation(14). There is a need for a chemical-free environment for dissection. When everything turns aesthetic and sustainable it is high time to come up with an alternative solution to a highly risky chemical , which in turn is much needed in a learning method.

In the process of learning anatomy the distant vision of treating of a human body stands up(1,15,16). So understanding the real nature of a human body is of utmost importance. The present study introduces a novel method of dissection and preservation of cadavers for learning anatomy and compares the conventional scalpel method for better understanding of the superiority and feasibility of the new technique.

Methodology

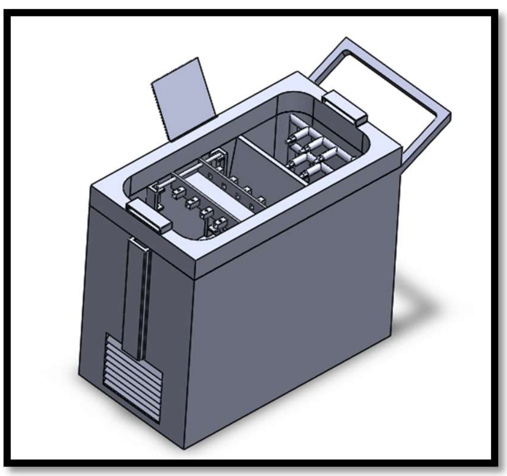
Sixteen cadaveric upper limb specimens from eight cadavers which were pre embalmed using Thiels embalming method, were obtained from the institution in accordance with ethical guidelines. All specimens were males. The age of the specimens ranges from 52 to 71. The inclusion criteria for selection of specimen is males aged 50 year old and above, with no visible structural abnormalities in palm, no surgical scars, all five fingers intact, no burns or other visible changes on the skin. All the specimens were embalmed and the the palm was cut at a position 5cm above the wrist joint. The specimens were individually procured and then transferred to the hydropreservation chamber where it is stored at a temperature of 2 degree celcius for seven consecutive days. All procedures were carried out by the author in compliance with institutional ethical standards for cadaveric research.

Dissection set up: The hydro-preserved specimen was placed in a purpose-built dissection container made of 308 grade stainless steel, designed and developed by the author(fig 1). It has parts to facilitate the process of dissection, along with add-ons like motor and hydor-jets to assist flow of water and also for changing water, compressor for adjusting temperature of water. A continuous flow of clean water at favourable temperature was maintained till the entire process of dissection was completed. An ideal temperature of 4 degree celsius was maintained inside the dissection chamber post storage of seven days. This was fixed after prior repeated trials. The water was regulated to produce gentle, non turbulent, laminar or streamlined flow. This was to aid in hydration – thus maintaining the moisture in tissues, preventing dessication, thus preserving the near physiological tissue integrity, turgor and elasticity.

Gentle hydraulic pressure through assisted equipments like pressure guns with multiple pointers are used for required spraying of water. The specimen being held in water reduces gravitational distortion of delicate structures, thus the relationship is maintained. The specimen submerged in water

remains soft and the hydraulic pressure assisted equipments aid in the separation of fascial planes without need of any sharp instruments.

Fig:1. Top view of hydropreservation and dissection machine. The double layered chamber, with the specimen holding cage, multi-nozzled pipelines for streamline flow and the screen.



Equipments:

Specially designed metallic bristle brush – flat and round, wooden bristle brush, natural boar brush, hard wire brush, scissors, forceps, bone cutters, probes, sand paper, Engraving pen with drill and polishing bits are used in hydropreservation and layer by layer non-scalpel dissection method

Dissection Protocol:

The hydropreservation and layer by layer non-scalpel dissection method follows a different pattern. Scalpel Incisions are completely avoided in this method. Instead, metallic bristles are used to delineate each layer from the adjacent, and the layers are reflected from medial to lateral or vice versa based on its connections with underlying structures. Skin flapping is done from medial to lateral side, as thumb is the most mobile part and so the skin over the medial part is loose, thus facilitating easy removal. Special care is taken while dissecting the anatomical web.

After preserving the specimen in the hydropreservation chamber in 2 degree celcius for seven days, expecting the complete dilution of Thiels embalming fluid, the specimen is taken out washed and the set in the dissection tray. The dorsal surface is to be dissected first. The epidermis, which is brown and dark is scrubbed using wooden bristle brushes and metallic bristle brushes. The epidermis is scraped off and it is histologically studied. Hard scrubbing is continued followed by fine scrubbing using the machine until the dermis is visible.The specimen is hydrated at regular intervals sing the hydro-jets, adjusting the flow and pressure as needed. The specimen is kept under water for one day, and then washed for removing the remnants of the skin – **epidermis**. Separation of structures using the metal dissection needles and forceps. A medial incision is taken, precisely from root of index finger-medial aspect down to root thumb and medial border upto corner of wrist joint. The crease in between the palm and digits are incised to mark the separation for two separate dissection of palm excluding digits and digits alone.

After scrubbing of the epidermis, **dermis** is separated from the underlying structures using needle and hard brush. In case of the digits, the epidermis is scrubbed off and each digit is incised along the medial side to refelect each layer by opening it to lateral side. From here, the dissection proceeds using 2 x zoom lens- dissection goggles for better understanding of the structures along with their integrity, texture, pattern etc. Metal bristles are used in the next step of dissection. **Superficial fascia** is observed, and the notable feature is the extensibility of fat distribution at various regions. The structures are embedded within superficial fascia. There are spaces along the distribution of fat in the superficial fascia and the spaces are identified. In the dorsal aspect, a thin and loose superficial fascia, which is clear and transparent is seen. The **superficial veins** are clearly visible through it, and the fat distribution is very less. There is no well-developed fibrous septa observed as seen in the palmar aspect. **Dorsal subcutaneous space** and **dorsal subaponeurotic spaces** are identified. There are very few nerve endings seen in this area.

Documentation: High resolution photographic documentation was carried out by author at each stage of dissection using a calibrated digital camera. Photographs were taken under standardized lighting condition for detailed structural photography. Structural findings were systematically recorded by the author against a predetermined observation checklist developed on the basis of established anatomical description from standard reference texts.

The author compared findings from hydropreservation and layer by layer non-scalpel dissection specimens with observations from conventional dissection. The analysis structured across parameters like structural integrity, fascial plane delineation, luminal patency of vessels, neural continuity and overall tissue quality.

Results

Dissection of the dorsal hand using the streamlined water submersion hydropreservation and layer by layer non-scalpel dissection technique yielded consistently superior anatomical preservation across all structures examined. The findings are summarized below with detailed comparative observations(18).

Superficial Layer

Skin: The skin of the dorsal hand was easily reflected and demonstrated remarkable pliability, closely approximating the elastic properties of fresh living tissue(fig 2). In contrast, formalin-fixed skin is characteristically rigid, brittle at margins, and prone to tearing, which complicates clean reflection and obscures the underlying superficial fascia.

Fig:2. Selected specimen- dorsum of palm with intact skin. Epidermis is exposed. This specimen was pre-cooled in cold stream at 2 degree celcius for seven days and then washed thoroughly.

Superficial Fascia: The superficial fascial layer was the most striking finding of this study. In the water-submerged specimen, the superficial fascia was identifiable as a discrete, well-defined areolar layer with clearly visible fascial planes on both its superficial and deep surfaces. This degree of delineation is rarely achievable in formalin-fixed specimens, where the superficial fascia tends to adhere to the overlying skin and the underlying dermis, becoming indistinguishable as a separate layer(fig 3).

Fig:3. Exposure of superficial fascia with uneven distribution of fat. Superficial vessels and fine nerves were identified. The fat has a variation of thickness with maximum at proximal and minimum at the distal. The superficial fascia and dermis was firmly adhered at the level of

Fig:4 Exposing of superficial fascia with vessels and reflection from lateral to medial side. The first layer of deep fascia is clearly visible underneath.

Dorsal Venous Network and Arch: The superficial dorsal veins, including the dorsal venous network of the hand and the dorsal venous arch, were remarkably well preserved(fig 4). The vessels maintained their luminal contour, appearing as patent, round or oval structures. The dorsal venous arch, in particular, retained its characteristic curved geometry and could be appreciated in full three-dimensional form. In contrast, formalin fixation commonly results in venous collapse, flattening, and loss of vascular architecture, reducing these structures to flattened ribbons that are difficult to trace.

Cutaneous Nerves: The cutaneous branches of the superficial radial nerve and the dorsal branch of the ulnar nerve were identified with continuity throughout their distribution in the dorsal hand. The water submersion environment allowed these delicate structures to be separated along their natural planes without mechanical transection. In conventional dissection, the fine caliber of these nerves places them at significant risk during sharp dissection, and their inadvertent transection is a recognized problem in formalin-fixed dissection settings.

Intermediate Layer

Extensor Retinaculum: The extensor retinaculum was clearly identifiable as a well-defined fibrous band traversing the dorsal wrist. Its fascial relationships with the overlying deep fascia and the underlying synovial compartments were intact and well-demonstrated. In formalin-fixed specimens, the retinaculum may require aggressive tissue clearance to expose fully, and its fascial relationships are often disrupted in the process.

Extensor Tendons and Tendon Sheaths: The extensor tendons of the digits were exposed with their synovial sheaths largely intact. The glistening appearance of the synovial lining, characteristic of fresh tissue, was visible and distinguishable from the tendon substance. This is in notable contrast to conventional dissection, where the tendon sheaths are frequently damaged or destroyed during layer-by-layer dissection, and the formalin-altered tissue loses the visual distinction between tendon and synovium.

Juncturae Tendinum (Intertendinous Connections): The juncturae tendinum — oblique fibrous bands connecting the extensor tendons in the dorsal hand — were consistently identified and preserved. These structures, which are of considerable surgical significance, are known to be vulnerable to disruption during conventional dissection. The atraumatic nature of hydropreservation and layer by layer non-scalpel dissectionfacilitated their exposure without disruption, allowing their variable morphology to be examined.

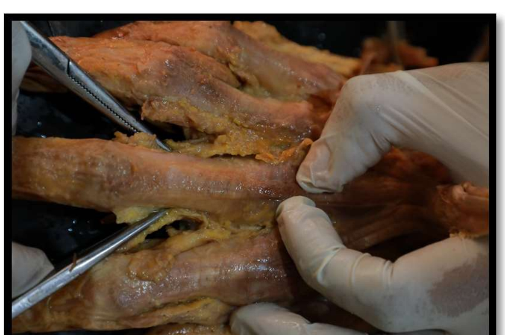
Dorsal Digital Expansions: The dorsal digital expansions (extensor hoods) were clearly delineated at each digit, with their lateral bands, oblique retinacular ligaments, and central slip components visible as distinct structural elements. This level of detail was achievable due to the preservation of the thin membranous fascial investments that form part of the expansion mechanism, which are commonly torn or lost in conventional dissection.

Deep Layer

Deep Fascia: The deep fascia of the dorsal hand was identifiable as a distinct layer separate from both the superficial fascia above and the dorsal interosseous fascia below. The preservation of this trilaminar fascial architecture (superficial fascia — deep fascia — interosseous fascia) is a significant finding, as it represents the true anatomical reality of the hand's fascial system, which is rarely demonstrable in formalin-fixed specimens(fig 5,6,7,8).

Fig:5 The display of three layers of deep fascia, extending and attaching to skin at the level of interphalangeal joint.

Fig:6 The first layer of deep fascia is reflected towards digits. The second layer of deep fascia is exposed. Tendons were present above and below the deep fascia and are clearly visible. The three layers of deep fascia are continuous from the level of extensor retinaculum.



Dorsal Interosseous Muscles: The four dorsal interosseous muscles were exposed with their

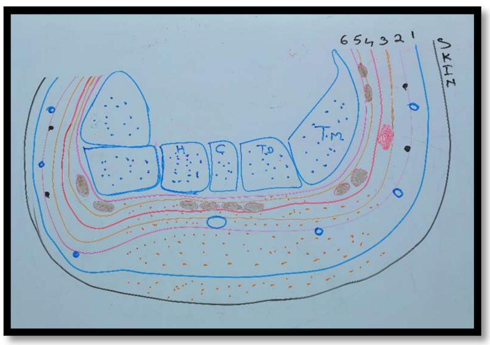
Fig: 7 The third layer of deep fascia is continuous with the digits.

overlying fascial investments intact. The topographical relationships of these muscles to the metacarpal shafts and to the overlying extensor tendons were clearly demonstrable. In conventional dissection, exposure of the interossei requires removal of considerable overlying tissue, during which the fascial coverings are typically sacrificed.

Dorsal Metacarpal Vessels: The dorsal metacarpal arteries, arising from the dorsal carpal arch, were identifiable in their course along the metacarpal shafts. Their branching patterns were better preserved under water submersion conditions, where the absence of vessel collapse and the maintained tissue turgor allowed visualization of even small perforating branches. These vessels are of increasing surgical importance given the role of dorsal metacarpal artery flaps in hand reconstruction.

Small Neural Branches: Fine digital neural branches were consistently identified and traced to their cutaneous distributions. The natural tissue planes maintained by the water submersion technique allowed these branches to be followed without sharp dissection in many instances, significantly reducing the risk of iatrogenic transection. This represents an important advantage for surgical anatomy teaching and neuroanatomical research(19–21).

Fig:8 A diagrammatic representation to demonstrate the extensiveness of superficial and deep fascia along with its relation with tendons, nerves and blood vessels, which is illustrated by the author as per his findings through this method.



Tissue Quality Observations

A consistently noted finding across all layers was the near-physiological quality of the tissue. The preserved hydration imparted a natural sheen and pliability to the specimen, and tissue coloration was maintained within a normal range (pale pink to cream for connective tissue, darker red-brown for muscle). These characteristics stand in stark contrast to the grey-brown, desiccated appearance characteristic of formalin-fixed specimens, and represent a significant advantage for educational realism and photographic documentation(table 1).

STRUCTURES	CONVENTIONAL DISSECTION	HYDRO-DISSECTION
Skin	Hard, rigid, dry and less pliable due to formalin fixation	Soft, easily separable, epidermis and dermis are visible on scraping each layer
Superficial fascia	Tightly packed, difficult to delineate the layers	Loosely dispersed layer, distinct fascial planes identified with minimal mechanical disruption
Extensor fascia	Dry, hard	Loosely dispersed layer and well differentiable
Retinaculum	Dry, differentiated	Soft, differentiated by viewing borders, clearly visualized with surrounding fascial relationships intact
Ante brachial fascia	Dry, thickened, adhered to muscle of forearm,	Soft, separable
Synovial sheath of flexor tendon	Frequently damaged during layer-by-layer dissection	Better preserved; intact synovial lining maintained
Synovial sheet of carpal extensors	Frequently damaged during layer-by-layer dissection	Better preserved; intact synovial lining maintained
Juncturae Tendinum	Sometimes disrupted during exposure	Preserved due to atraumatic plane separation
Facial arrangements at dorsum of hand	Deep fascia often merged with adjacent connective tissue	Distinct fascial layers clearly visible
Lumbricals – Extensor lumbricals	Identified after extensive tissue removal	Exposed with surrounding fascia intact

Interosseus- dorsal interosseus	Identified after extensive tissue removal	Exposed with surrounding fascia intact
Radial artery	Visible	Easily seperable, luminous integrity maintained
Radial Nerve – post interosseus nerve	Difficult to preserve; high transection risk	More consistently identified along natural planes
Cutaneous nerve – ulnar and radial	Risk of accidental transection during dissection	Separated along natural planes without any trauma, branching pattern preserved well.
Arterial supply – Dorsal carpal branches of radial artery	Compressed and distorted,	Anatomicall y preserved and expanded, palpable
Small dorsal digital arteries	Visible but compressed	Visible, palpable well enough as they are not compressed.
2, 3, 4 dorsal metacarpal arteries	Visible, but cannot be differentiated	Visible and well differentiate d
Cephalon vein Dorsal Venous Network Dorsal metacarpal vein Dorsal digital vein	Flattened or sometimes collapsible, luminal integrity compromised	Vascular architecture is well maintained with good luminal contour
Synovial sheath Annular fibres in digital sheath	Can be differentiated	Easily distinguisha ble and differentiabl e
Cruciate fibres in digital sheath		
Radio carpal joint Palmer radio carpal ligament Parmar ulnar carpal ligament Dorsal radio carpel ligament	All these structures were identifiable	Identifiable and the consistency of the structures were notable
Inter carpal joints Interosseus ligament Piso hamate and piso meta carpal ligament	Identified	Identified with ease, ligament has a reflective nature due to glassy appearance
Compound articulation of mid carpal region - Planar joint	Cannot be identified	Easily identified
Dorsal and Palmer Ligaments Collateral ligament Carpal synovial membrane	Cannot be identified due to dryness	Identifies as soft structures, the bone at the synovial joint appears to have a reflective nature due to the glassy appearance
Carpo metacarpal joint	Intact, but stiff	Intact, movable at ease
Tendons and insertions of extensor group of Ante brachial muscles	Identified after removal of fascia and fat layers	Tendons exposed while preserving synovial surrounding s

Table 1: Structures identified are enumerated and the consistency and physical features are explained and are compared along the conventional dissection findings

Discussion

The findings of this study demonstrate that streamlined water submersion hydropreservation and layer by layer non-scalpel dissectionoffers consistent and reproducible advantages over conventional formalin-fixed cadaveric dissection in the examination of dorsal hand anatomy. These advantages span all anatomical layers, from the superficial fascia to the deep interosseous compartment, and are particularly pronounced for structures of fine caliber and delicate architecture.

Fascial Plane Preservation

Perhaps the most significant finding of this study is the superior preservation of fascial planes. The fascia of the hand exists as a complex, multi-layered system that is critical to understanding the spread of infection, the pathophysiology of compartment syndrome, the behavior of Dupuytren's contracture, and the principles of fascial flap design in reconstructive surgery. The ability to demonstrate the superficial fascia, deep fascia, and interosseous fascia as distinct, visually separable layers — as achieved in this study — represents an anatomical finding of considerable educational and clinical relevance(22).

The mechanism by which water submersion facilitates fascial plane preservation is likely multifactorial. The aqueous environment prevents the desiccation-induced tissue adhesion that occurs in air-exposed specimens. The streamlined water flow provides gentle hydraulic pressure that naturally separates areolar tissue planes. The absence of chemical fixation means that the natural hydrophilic properties of fascial connective tissue are maintained, allowing these structures to retain their normal architecture(23).

Neurovascular Preservation

The consistent identification and preservation of small neurovascular structures — including cutaneous nerve branches, dorsal metacarpal vessels, and fine digital neural branches — represents another key advantage of this technique. These structures are of direct surgical relevance; the dorsal metacarpal arteries are the basis of the dorsal metacarpal artery flap, a workhorse flap in hand reconstruction, while the cutaneous branches of the superficial radial nerve are frequently at risk in dorsal hand surgery(24).

The ability to demonstrate these structures in their natural, non-collapsed state provides a qualitatively superior educational experience and more accurately reflects the surgical reality that trainees will encounter in the operating theatre. This is consistent with the broader literature on fresh tissue dissection, which has consistently demonstrated superior neurovascular preservation compared to formalin-fixed approaches.

Educational Implications

The near-physiological appearance of the hydrodissected specimen carries significant implications for anatomical education. Color recognition, tissue texture, and structural relationships are important components of anatomical learning that are poorly conveyed by the altered appearance of formalin-fixed specimens. A specimen that retains natural color, pliability, and tissue turgor provides a more authentic and memorable learning experience, potentially improving the retention of anatomical knowledge and its transfer to clinical settings.

Furthermore, the photographic documentation of hydrodissected specimens produces images of substantially higher educational quality, with natural tissue contrast allowing clear delineation of structures that would otherwise require supplementary labelling or color enhancement in conventional dissection photographs.

Environmental and Safety Considerations

Formalin (formaldehyde) is a recognized human carcinogen and poses significant occupational health risks in anatomical laboratories. (25)The regulatory burden associated with its storage, use, and disposal is considerable, and formalin-related health concerns have been a driver of interest in alternative preservation methods. The water submersion technique described in this study requires no chemical fixatives, generating no toxic waste and imposing no chemical hazard on students or faculty. This represents an important safety and sustainability advantage, particularly for institutions in resource-limited settings.

Limitations

This study has several limitations that must be acknowledged. First, the use of a single cadaveric specimen limits the generalizability of the findings and does not permit statistical analysis. Future studies with larger sample sizes are required to confirm these observations and to quantify the degree of preservation advantage. Second, the absence of histological analysis in this study means that microstructural preservation could not be assessed at the cellular level. Histological comparison of hydrodissected versus formalin-fixed tissue would provide important supplementary data. Third, the duration of adequate preservation using the water submersion technique requires systematic investigation; unlike formalin fixation, water submersion does not provide long-term tissue preservation, and autolytic changes may limit the useful window for dissection. Finally, the comparison in this study is with published descriptions of conventional dissection rather than a simultaneously prepared paired specimen, which introduces a potential source of bias.

Future Directions

Future research should address the above limitations through prospective, paired comparative studies using fresh tissue control specimens. Investigation of optimal water temperature, flow rate, and submersion duration would assist in protocol standardization. The applicability of the technique to other anatomical regions — particularly areas of complex fascial architecture such as the deep neck, the popliteal fossa, and the plantar foot — warrants systematic exploration. The integration of hydropreservation and layer by layer non-scalpel dissectionwith near-infrared imaging or fluorescence-guided dissection techniques may further enhance neurovascular visualization.

Conclusion

This study presents the first systematic description of a streamlined water submersion hydropreservation and layer by layer non-scalpel dissectiontechnique applied to cadaveric anatomical dissection of the dorsal hand. The technique demonstrates consistent superiority over conventional formalin-based dissection in the preservation of fascial planes, neurovascular structures, tendon sheaths, and microanatomical detail across all fifteen structures examined. Near-physiological tissue appearance, environmental safety, and technical accessibility make this approach a promising addition to the anatomical educator's toolkit.

While further validation through larger comparative studies is required, the findings of this study suggest that water submersion hydropreservation and layer by layer non-scalpel dissectionmerits serious consideration as an alternative or complementary approach to conventional cadaveric dissection, with potential benefits for anatomical education, surgical training, and anatomical research

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Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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