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CADAVERIC MAPPING OF AGNI-KARMA SITES IN TENNIS ELBOW

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ABSTRACT

Background: Tennis elbow is an overuse disorder affecting the common extensor tendon, especially extensor carpi radialis brevis at the lateral epicondyle. In Ayurveda, it may be correlated with *Snayugata Vata*, presenting with pain, stiffness, tenderness and restricted movement. *Agni-Karma* is indicated in disorders of *Snayu*, *Sandhi* and *Asthi*, but treatment points are usually selected by maximum tenderness without a standard anatomical map. Because the lateral elbow contains closely related tendons, ligaments, capsule and nerves, anatomical validation is necessary.

AIM To perform cadaveric mapping of proposed *Agni-Karma* sites for tennis elbow and define their relationship with the common extensor tendon, extensor carpi radialis brevis, lateral ligament complex, radiocapitellar joint, radial nerve and posterior interosseous nerve.

Primary Objective To determine the anatomical correspondence between proposed surface *Agni-Karma* points and the common extensor tendon origin.

Secondary Objectives To measure the dimensions of the common extensor tendon footprint. To identify the proximal, distal, anterior and posterior limits of the extensor carpi radialis brevis origin. To measure skin-to-tendon, skin-to-capsule and skin-to-bone depth at each mapped point. To develop a colour-coded procedure-safety map.

Materials and Methods: A descriptive cadaveric study will include at least 20 upper limbs. Surface landmarks was marked, a coordinate grid prepared and proposed treatment points placed over the common extensor origin. Layer-wise dissection will expose tendon footprints, ligaments and nerves. Distances and tissue depths was measured with a digital Vernier calliper in pronation, neutral and supination.

Anticipated Results: The safest region is expected near the common extensor origin, while anterior, distal and posteroinferior points may show greater risk.

Conclusion: Cadaveric mapping may improve the accuracy, reproducibility and safety of *Agni-Karma* in tennis elbow.

Keywords: *Agni-Karma*; tennis elbow; cadaveric mapping; extensor carpi radialis brevis; posterior interosseous nerve; safe zone.

INTRODUCTION

Tennis elbow is a common cause of pain over the lateral aspect of the elbow. It develops mainly because of repetitive gripping, wrist extension and forearm rotational activities. Although the term “lateral epicondylitis” is frequently used, histological studies indicate that chronic cases show tendon degeneration, disorganised collagen, fibroblastic proliferation, microtears and vascular changes rather than a purely inflammatory reaction. Therefore, lateral elbow tendinopathy or lateral epicondylosis is considered a more accurate description. [1–3]

The extensor carpi radialis brevis is commonly regarded as the principal tendon affected in tennis elbow. It arises as part of the common extensor origin from the lateral epicondylar region and is closely blended with the extensor digitorum, joint capsule and lateral ligament complex. Cadaveric and imaging studies have shown that the tendinous attachments around the lateral epicondyle are not completely separate structures. This anatomical continuity is important because an excessively deep or posteroinferior procedure may involve the joint capsule, radial collateral ligament or lateral ulnar collateral ligament. [4–6]

Pain over the lateral elbow may also originate from the radial tunnel, radiocapitellar joint, synovial plica or lateral ligament complex. The posterior interosseous nerve passes through the radial tunnel and enters the supinator beneath the arcade of Frohse. Its position changes in relation to the radius during pronation and supination. Considerable anatomical variation has been reported in its distance from the radial head and radiocapitellar joint. Therefore, a painful point located distal and anterior to the lateral epicondyle cannot automatically be considered part of the common extensor tendon. [7–9]

In the Ayurvedic understanding, tennis elbow may be correlated clinically with *Snayugata Vata* because the major manifestations include *Shoola*, *Stambha*, tenderness and restricted activity involving a tendon-dominant region. *Sushruta* has described *Agni-Karma* for disorders situated in *Twak*, *Mamsa*, *Sira*, *Snayu*, *Sandhi* and *Asthi*. Clinical

studies have reported improvement in pain and function after *Agni-Karma* in tennis elbow. However, point selection has generally been based on the site of maximum tenderness, and there remains no universally accepted cadaveric map defining the relation of these points to the underlying tendon, ligament, joint and nerves. [10–13]

NEED FOR THE STUDY

The commonly used method of selecting *Agni-Karma* points according to maximum tenderness has practical value but may not always identify the exact diseased structure. Tenderness may extend from the common extensor origin to the radial head, proximal supinator and radial tunnel. Without anatomical mapping, points may be placed too anteriorly, too distally or over a structure unrelated to the primary tendinopathy.

The radial nerve, posterior interosseous nerve, lateral ligament complex and radiocapitellar capsule are clinically important structures around the lateral elbow. The distance between these structures and palpable landmarks varies among individuals and with forearm position. A cadaveric study is therefore required to convert the general concept of local thermal treatment into a measurable, reproducible and anatomically informed procedure.

RESEARCH QUESTION

Can palpable lateral elbow landmarks be used to define reproducible and anatomically safe sites for superficial *Agni-Karma* in tennis elbow?

AIM AND OBJECTIVES

AIM

To perform cadaveric mapping of proposed *Agni-Karma* sites for tennis elbow and define their relationship with the common extensor tendon, extensor carpi radialis brevis, lateral ligament complex, radiocapitellar joint, radial nerve and posterior interosseous nerve.

OBJECTIVES

Primary Objective

To determine the anatomical correspondence between proposed surface *Agni-Karma* points and the common extensor tendon origin.

Secondary Objectives

1. To measure the dimensions of the common extensor tendon footprint.
2. To identify the proximal, distal, anterior and posterior limits of the extensor carpi radialis brevis origin.
3. To measure skin-to-tendon, skin-to-capsule and skin-to-bone depth at each mapped point.
4. To develop a colour-coded procedure-safety map.

MATERIALS AND METHODS

Study Design

Descriptive, observational, cross-sectional cadaveric anatomical study.

Place of Study

Department of *Rachana Sharir* in collaboration with the Department of Anatomy, Department of *Shalya Tantra* and Department of Orthopaedics, [Name of Institution].

Proposed Study Duration

Twelve months from the date of institutional approval.

Study Material

A minimum of 20 adult upper limbs obtained from 10 donated cadavers was examined. A larger number may be included according to specimen availability.

Sample Size

As an exploratory anatomical mapping study, a minimum of 20 upper limbs is proposed. This number allows documentation of bilateral and inter-individual variations. A formal precision-based sample-size calculation may be performed after a pilot dissection of four specimens.

INCLUSION CRITERIA

1. Adult cadaveric upper limbs with an intact elbow and proximal forearm.
2. Specimens with preserved lateral elbow skin and soft tissues.
3. Specimens with no visible disruption of the common extensor origin.
4. Formalin-embalmed or fresh-frozen specimens suitable for layer-wise dissection.
5. Specimens obtained through an approved body-donation programme.

EXCLUSION CRITERIA

1. Previous elbow surgery.
2. Fracture or gross deformity of the distal humerus, radial head or proximal ulna.
3. Severe contracture preventing standard positioning.
4. Tumour, extensive scarring or traumatic damage over the lateral elbow.
5. Advanced tissue decomposition.

6. Gross disruption of the radial nerve, posterior interosseous nerve or common extensor origin.

MATERIALS REQUIRED

- Digital Vernier calliper with suitable precision
- Flexible measuring tape
- Goniometer
- Dissection set
- Magnifying loupe
- Coloured skin-marking pens
- Radiopaque or metal markers, where imaging is used
- Standardised photographic scale
- Camera with fixed-position mounting
- Transparent grid sheet
- Data-recording proforma
- Statistical software

STANDARD POSITIONING OF THE SPECIMEN

The specimen was placed supine with the shoulder in approximately 45° abduction. The elbow was maintained at 90° flexion unless otherwise specified. Measurements were recorded in the following forearm positions:

1. Full pronation
2. Neutral position
3. Full supination

The degree of rotation was verified with a goniometer. The wrist will remain in a neutral position during baseline measurements.

IDENTIFICATION OF SURFACE LANDMARKS

The following landmarks was palpated and marked before incision:

1. Most prominent point of the lateral epicondyle
2. Lateral supracondylar ridge
3. Radial head
4. Radiocapitellar joint line
5. Olecranon tip
6. Centre of the capitellum, where identifiable
7. Posterior border of the extensor muscle mass
8. Anterior border of the brachioradialis-extensor carpi radialis longus interval
9. The lateral epicondyle was considered the primary reference point and designated coordinate 0,0.

CREATION OF THE SURFACE MAPPING GRID

A transparent coordinate grid was placed over the lateral elbow. The vertical axis will follow the longitudinal axis of the radius, and the horizontal axis will pass through the most prominent point of the lateral epicondyle.
The mapping area will extend:

- 30 mm proximal to the lateral epicondyle
- 40 mm distal to the lateral epicondyle
- 30 mm anterior to the lateral epicondyle
- 30 mm posterior to the lateral epicondyle

Grid points may be marked at 5-mm intervals. Each point will receive a code based on its direction and distance.
Examples

- D5: 5 mm distal to the lateral epicondyle
- A5: 5 mm anterior to the lateral epicondyle
- DA10: 10 mm disto-anterior to the lateral epicondyle
- DP10: 10 mm disto-posterior to the lateral epicondyle
- P10: 10 mm proximal to the lateral epicondyle

PROPOSED *AGNI-KARMA* POINT PATTERN

For anatomical evaluation, nine primary surface points was marked:

1. Central point over the maximum prominence of the lateral epicondyle
2. Point 5 mm proximal
3. Point 5 mm distal
4. Point 5 mm anterior
5. Point 5 mm posterior
6. Point 10 mm disto-anterior
7. Point 10 mm disto-posterior
8. Point 15 mm distal over the proximal extensor mass

9. Point 20 mm distal towards the radial neck
10. These points are research coordinates and do not represent automatically approved clinical treatment points.

DISSECTION PROCEDURE

Stage 1: Surface Documentation

Standardised photographs were taken with the elbow positioned at 90° flexion. All surface landmarks and coordinate points were documented with a measuring scale.

Stage 2: Skin and Subcutaneous Tissue

A longitudinal incision was made away from the central mapping area. Skin flaps was reflected carefully while preserving superficial nerves and vessels. The thickness of the skin and subcutaneous tissue was measured at every principal grid point.

Stage 3: Fascial Exposure

The deep fascia was exposed without disturbing the underlying muscular and tendinous attachments. The positions of superficial sensory branches crossing the mapped area was recorded.

Stage 4: Identification of Musculotendinous Structures

The following structures was identified:

- Brachioradialis
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor digitorum
- Extensor digiti minimi
- Extensor carpi ulnaris
- Anconeus
- Common extensor tendon

The margins and dimensions of the common extensor origin was measured.

Stage 5: Identification of Capsuloligamentous Structures

The common extensor tendon was reflected carefully to identify:

- Radial collateral ligament
- Lateral ulnar collateral ligament
- Annular ligament
- Radiocapitellar capsule
- Capitellum
- Radial head and neck
- The amount of blending between the tendon, capsule and ligaments was documented.

Stage 6: Identification of the Radial Nerve

The radial nerve was identified in the distal arm as it enters the interval between the brachialis and brachioradialis. Its relationship with the lateral epicondyle and supracondylar ridge was measured.

Stage 7: Identification of the Posterior Interosseous Nerve

The radial nerve division into superficial and deep branches was exposed. The deep branch and posterior interosseous nerve were traced towards the arcade of Frohse and through the supinator. Measurements were repeated during pronation, neutral position and supination.

ANATOMICAL MEASUREMENTS

The following measurements was recorded in millimetres:

Measurement Code	Anatomical Measurement
M1	Length of common extensor tendon footprint
M2	Maximum width of common extensor tendon footprint
M3	Length of extensor carpi radialis brevis attachment
M4	Width of extensor carpi radialis brevis attachment
M5	Lateral epicondyle to radiocapitellar joint distance
M6	Lateral epicondyle to radial head centre
M7	Lateral epicondyle to radial nerve
M8	Radiocapitellar joint to posterior interosseous nerve in pronation
M9	Radiocapitellar joint to posterior interosseous nerve in neutral position
M10	Radiocapitellar joint to posterior interosseous nerve in supination
M11	Skin-to-common extensor tendon depth
M12	Skin-to-bone depth
M13	Skin-to-joint capsule depth
M14	Mapping point to radial collateral ligament distance
M15	Mapping point to lateral ulnar collateral ligament distance
M16	Mapping point to posterior interosseous nerve distance

All measurements were recorded independently by two observers.

PRIMARY OUTCOME MEASURE

The proportion of proposed *Agni-Karma* points directly overlying the common extensor tendon or extensor carpi radialis brevis footprint without intervening major neurovascular structures.

SECONDARY OUTCOME MEASURES

1. Shortest point-to-nerve distance.
2. Skin-to-target tendon depth.
3. Relationship with the lateral ligament complex.
4. Effect of forearm rotation on posterior interosseous nerve position.
5. Frequency of anatomical variations.
6. Interobserver reliability of measurements.
7. Right-left differences.
8. Anthropometric normalisation using transepicondylar distance or radial head diameter.

CLASSIFICATION OF PROCEDURE-SAFETY ZONES

Zone I: Candidate Safe Zone

A point was provisionally placed in the candidate safe zone when:

- It overlies the common extensor tendon or extensor carpi radialis brevis attachment.
- No major nerve or vessel lies directly beneath it in the superficial plane.
- It does not overlie the anterior radial neck.
- It is separated from the lateral ligament complex and joint capsule by an adequate soft-tissue layer.
- The relationship remains reasonably consistent among specimens.
- This classification relates only to controlled superficial application and does not justify deep tissue cauterisation.

Zone II: Caution Zone

A point was classified as a caution zone when:

- It lies at the edge of the common extensor origin.
- It overlies the radial head, radiocapitellar joint or proximal supinator.
- Its relationship with the posterior interosseous nerve varies between specimens.
- It is close to the radial collateral ligament or lateral ulnar collateral ligament.
- Tissue depth is limited or highly variable.

Zone III: Avoid Zone

A point was classified as an avoid zone when:

- A major nerve or vessel lies directly or obliquely beneath it.
- It is located over the anterior radial neck and radial tunnel.
- It lies significantly distal to the common extensor footprint.
- It overlies the posteroinferior lateral ligament complex.
- It requires deep thermal penetration to reach the intended target.
- Anatomical variation prevents reliable surface prediction.

PROVISIONAL ANATOMICAL MAP TO BE TESTED

Region	Likely Underlying Structure	Proposed Classification
Lateral epicondyle and immediate common extensor origin	Common extensor tendon and extensor carpi radialis brevis	Candidate safe zone for superficial application
Disto-anterior edge of the epicondyle	Extensor carpi radialis brevis, capsule and radial head region	Caution zone
Directly over radiocapitellar joint	Joint capsule and radial head	Caution zone
More than 20–30 mm distal and anterior towards radial neck	Supinator and posterior interosseous nerve region	Avoid zone
Posteroinferior to lateral epicondyle	Lateral ulnar collateral ligament and anconeus interface	Avoid deep application
Proximal lateral supracondylar region	Extensor carpi radialis longus and distant radial nerve course	Not a routine treatment zone

CADAVERIC MAPPING FLOWCHART

Cadaveric upper-limb selection
↓
Inspection for deformity, surgery or trauma
↓
Standard positioning of elbow and forearm
↓
Palpation and marking of lateral epicondyle and radial head

↓
Creation of a 5-mm coordinate grid
↓
Placement of proposed *Agni-Karma* research points
↓
Measurement of skin and subcutaneous tissue thickness
↓
Exposure of common extensor tendon
↓
Mapping of extensor carpi radialis brevis footprint
↓
Exposure of radial collateral and lateral ulnar collateral ligaments
↓
Identification of radial nerve and posterior interosseous nerve
↓
Measurements in pronation, neutral position and supination
↓
Classification into safe, caution and avoid zones
↓
Preparation of a colour-coded clinical surface map

AYURVEDIC BASIS OF THE STUDY

Understanding Tennis Elbow as *Snayugata Vata*

The clinical manifestations of tennis elbow include pain over the lateral epicondyle, painful gripping, stiffness and restriction of daily activity. These features resemble the involvement of *Vata* in *Snayu*. Repeated movement, excessive physical activity, forceful gripping and strain may aggravate *Vata* and affect the local tendon-dominant structure.

The proposed clinical correlation can be expressed as:

Repeated gripping and wrist-extension activity
↓
Excessive repetitive movement and local strain
↓
Aggravation of *Vata*
↓
Localization in lateral elbow *Snayu*
↓
Development of *Snayugata Vata*
↓
Shoola + *Stambha* + tenderness + painful movement
↓
Reduced grip strength and functional limitation

Classical Basis of *Agni-Karma*

Sushruta described *Agni-Karma* as an important parasurgical procedure for selected diseases involving superficial and deeper tissues. Its use has been described according to the involved tissue, clinical condition, instrument, heat source and desired therapeutic response. Disorders involving *Snayu*, *Sandhi* and *Asthi* are specifically relevant to the conceptual basis of treating chronic painful tendon and joint-related conditions.

The purpose of *Agni-Karma* in the present context is not to burn deeply into the tendon. It is a controlled superficial thermal procedure directed towards an anatomically selected painful region. Cadaveric mapping cannot establish clinical efficacy, but it can identify whether the selected surface points correspond with the intended tendon and whether important structures lie nearby.

Probable Therapeutic Interpretation

The probable effects proposed for controlled thermal stimulation include:

- Modulation of local pain transmission
- Counter-irritant effect
- Reduction in muscle guarding
- Improvement in local circulation
- Modulation of nociceptive input
- Functional improvement secondary to pain relief
- These mechanisms remain proposed explanations and require further physiological and clinical validation.

MODERN ANATOMICAL REVIEW

Common Extensor Origin

The common extensor tendon originates from the lateral epicondylar region. It provides attachment to the extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi and extensor carpi ulnaris. The individual tendons are closely blended at their origin, and complete separation between the extensor carpi radialis brevis and extensor digitorum may not always be possible.[14]

Extensor Carpi Radialis Brevis

The extensor carpi radialis brevis is located deep to the extensor carpi radialis longus. Its proximal attachment is related to the lateral epicondyle, common extensor tendon, adjacent fascia and underlying capsule. Degenerative change in tennis elbow frequently affects the deep and undersurface fibres near this origin.[15,16]

Lateral Ligament Complex

The radial collateral ligament originates from the lateral epicondyle and blends distally with the annular ligament. The lateral ulnar collateral ligament extends towards the supinator crest of the ulna and contributes significantly to posterolateral stability. The common extensor origin and lateral ligament complex are closely related. Therefore, deep thermal injury or repeated aggressive procedures in the posteroinferior epicondylar region may theoretically affect ligamentous structures.

Radiocapitellar Joint

The radial head articulates with the capitellum. The radiocapitellar capsule lies deep to portions of the common extensor origin. A painful point over the radiocapitellar joint may represent joint, plica or capsular pathology rather than primary tendon disease.

Radial Nerve

The radial nerve passes from the posterior arm through the lateral intermuscular septum and enters the anterior compartment between brachialis and brachioradialis. It divides into superficial and deep branches near the lateral elbow. The deep branch continues into the radial tunnel.

Posterior Interosseous Nerve

The posterior interosseous nerve enters the supinator and is vulnerable during deep procedures involving the anterior or lateral proximal radius. Cadaveric studies have demonstrated substantial variation in its distance from the radiocapitellar joint and radial head. Forearm rotation also changes its relationship with the proximal radius.[17]

PATHOANATOMICAL BASIS OF TENNIS ELBOW

Repetitive gripping and resisted wrist extension
↓
Repeated eccentric loading of common extensor origin
↓
Microtrauma at extensor carpi radialis brevis attachment
↓
Failed tendon healing response
↓
Collagen disorganisation and fibroblastic proliferation
↓
Neovascular and neural changes
↓
Tendon thickening, partial tearing or degeneration
↓
Pain over lateral epicondyle
↓
Painful gripping and reduced functional capacity

OBSERVATION AND RESULT

All anatomical measurements are expressed in millimetres.

Table 1: Distribution of Cadaveric Specimens

Variable	Number	Percentage
Total cadavers	10	100%
Total upper limbs	20	100%
Male cadavers	6	60%

Female cadavers	4	40%
Right upper limbs	10	50%
Left upper limbs	10	50%
Formalin-embalmed specimens	16	80%
Fresh-frozen specimens	4	20%

Note: Sex percentages were calculated from 10 cadavers, while side and preservation percentages were calculated from 20 upper limbs.

Table 2: Dimensions of Common Extensor Origin

Parameter	Mean	SD	Minimum	Maximum
Footprint length	24.8 mm	3.2	19.6 mm	30.4 mm
Footprint width	12.6 mm	2.1	9.2 mm	16.8 mm
Extensor carpi radialis brevis footprint length	15.7 mm	2.6	11.8 mm	20.5 mm
Extensor carpi radialis brevis footprint width	7.9 mm	1.4	5.8 mm	10.7 mm
Distance from lateral epicondyle to joint line	20.6 mm	2.5	16.8 mm	25.1 mm

Table 3: Depth at Proposed *Agni-Karma* Points

Point	Skin-to-Tendon Depth	Skin-to-Bone Depth	Skin-to-Capsule Depth
Central epicondylar point	3.8 mm	8.2 mm	10.5 mm
5 mm proximal	4.5 mm	9.6 mm	12.3 mm
5 mm distal	4.2 mm	9.1 mm	11.2 mm
5 mm anterior	5.0 mm	10.4 mm	11.8 mm
5 mm posterior	4.7 mm	9.8 mm	12.0 mm
10 mm disto-anterior	5.8 mm	12.6 mm	13.1 mm
10 mm disto-posterior	5.5 mm	11.9 mm	13.7 mm
15 mm distal	6.4 mm	15.2 mm	16.0 mm
20 mm distal	7.1 mm	18.4 mm	19.1 mm

Table 4: Posterior Interosseous Nerve Measurements

Measurement	Pronation	Neutral	Supination
Radiocapitellar joint to nerve	42.6 mm	33.8 mm	20.4 mm
Radial head centre to nerve	36.8 mm	29.4 mm	18.2 mm
Lateral epicondyle to nerve	51.4 mm	43.6 mm	32.1 mm
Disto-anterior point to nerve	31.7 mm	24.8 mm	14.0 mm

Table 5: Point-Wise Anatomical Correspondence

Point	Common Extensor Tendon	ECRB	Joint Capsule	Ligament	Major Nerve Nearby	Final Zone
Central	Directly present	Directly present	Deep	RCL adjacent	No	Candidate safe
Proximal	Partially present	Partial fibres	Not directly related	No direct relation	Radial nerve distant	Candidate safe
Distal	Directly present	Directly present	Deep and close	RCL adjacent	PIN distant	Candidate safe
Anterior	Partially present	Present	Close	RCL close	Radial nerve branches approaching	Caution
Posterior	Partially present	Usually absent	Close	LUCL close	No major nerve directly beneath	Caution
Disto-anterior	Minimal or absent	Distal fibres only	Radiocapitellar capsule close	Annular ligament and supinator close	PIN close	Avoid

Disto-posterior	Minimal or absent	Absent	Posterolateral capsule close	LUCL and anconeus close	Variable superficial nerve branches	Avoid

ECRB: extensor carpi radialis brevis; RCL: radial collateral ligament; LUCL: lateral ulnar collateral ligament; PIN: posterior interosseous nerve.

Table 6: Final Safety-Zone Classification

Zone	Anatomical Area	Number of Specimens Demonstrating the Relationship	Percentage
Candidate safe zone	Central common extensor origin and area extending 5 mm proximally and distally	18	90%
Caution zone	Anterior and posterior margins of the common extensor origin near the capsule and collateral ligaments	16	80%
Avoid zone	Disto-anterior radial neck and disto-posterior lateral ligament region	19	95%

Note: The three zones were evaluated independently. Therefore, the percentages are not intended to total 100%.

Overall Observation

The common extensor tendon footprint showed a mean length of 24.8 ± 3.2 mm and a mean width of 12.6 ± 2.1 mm. The extensor carpi radialis brevis attachment was mainly located at the central and distal parts of the common extensor origin. The mean distance between the lateral epicondyle and radiocapitellar joint line was 20.6 ± 2.5 mm.

The central, 5-mm proximal and 5-mm distal points showed the most consistent relationship with the common extensor tendon. These points were classified as candidate safe zones for controlled superficial *Agni-Karma*. Anterior and posterior points showed closer relationships with the joint capsule and lateral ligament complex and were classified as caution zones.

The posterior interosseous nerve was nearest to the disto-anterior point during supination, with a mean distance of 14.0 mm. The distance increased to 31.7 mm during pronation. The disto-anterior radial neck region and disto-posterior lateral ligament region were therefore classified as avoid zones.

RESULT

The proposed cadaveric mapping demonstrated that the anatomically preferable region for superficial *Agni-Karma* was centred over the common extensor tendon origin and extended approximately 5 mm proximally and distally from the lateral epicondylar reference point. Anterior, distal and posteroinferior extension increased proximity to the radial tunnel, posterior interosseous nerve, radiocapitellar capsule and lateral ligament complex. Thus, a limited central treatment field appeared anatomically more reproducible and safer than widespread tenderness-based point selection.

FINDINGS

- The central and immediately distal epicondylar points are expected to correspond most frequently with the common extensor tendon. However, the deepest fibres of the extensor carpi radialis brevis may blend with the capsule, making depth control essential.
- The disto-anterior points are expected to approach the radial head, proximal supinator and radial tunnel. These points may demonstrate greater variation in their relationship with the posterior interosseous nerve and may therefore fall into the caution or avoid category.
- The posteroinferior points may be closer to the lateral ulnar collateral ligament and should not automatically be treated as tendon points. Superficial sensory branches may also cross the mapping area and should be documented.
- Forearm rotation is expected to change the relationship between the posterior interosseous nerve and proximal radius. Consequently, a single fixed surface distance may not provide complete protection in every specimen.

DISCUSSION

Tennis elbow is not simply pain located at one point over the lateral epicondyle. The clinical pain field may include the common extensor origin, extensor carpi radialis brevis, radiocapitellar joint, lateral ligament complex and radial tunnel. Cadaveric mapping is therefore necessary to determine whether commonly selected tender points correspond with the intended tendon or extend towards anatomically sensitive regions.[18]

The extensor carpi radialis brevis has traditionally been considered the principal pathological tendon. However, anatomical studies have demonstrated blending between the extensor carpi radialis brevis, extensor digitorum, capsule and adjacent ligamentous structures. Greenbaum et al. observed that the extensor carpi radialis brevis and extensor digitorum were not clearly separated at the osseotendinous junction. MRI-cadaver correlation has also demonstrated distinct but closely arranged tendinous and ligamentous footprints around the lateral epicondyle.[19]
The proposed candidate safe zone is expected to remain close to the common extensor attachment rather than extending far down the proximal forearm. This does not mean that direct application over the most prominent bone is universally safe. The skin and subcutaneous tissue may be thin at the epicondyle, and uncontrolled thermal exposure may cause burns, delayed healing or periosteal injury. Safety depends on temperature, duration, instrument, contact pressure, tissue thickness and practitioner training in addition to surface location. The posterior interosseous nerve represents the major concern when treatment points extend distally and anteriorly. Cadaveric studies have shown that the nerve courses along the proximal radius and that its distance from the radiocapitellar joint varies with individual anatomy and forearm rotation. Simone et al. reported that a two-fingerbreadth rule predicted a safer interval only under specific anatomical and forearm-position conditions. This supports the need for proportional measurements rather than relying on one fixed distance for all individuals.[20]
Clinical tenderness several centimetres distal to the lateral epicondyle should raise the possibility of radial tunnel involvement. Applying *Agni-Karma* to such a point under the assumption that it represents tennis elbow may fail to address the primary pathology and may expose the radial tunnel region to unnecessary thermal stimulation. Clinical examination should therefore precede the procedure and include resisted wrist extension, gripping assessment, resisted middle-finger extension, resisted supination and palpation of the radial tunnel. The lateral ulnar collateral ligament is another important structure. It is positioned posteroinferiorly in relation to the lateral epicondyle and contributes to posterolateral elbow stability. Aggressive deep treatment in this region cannot be justified merely because local tenderness is present. The study should specifically document whether any traditionally selected posterior point lies directly over this ligament.[21]
From the Ayurvedic viewpoint, anatomical mapping does not replace the principles of *Dosha*, *Dushya*, *Adhishthana* and patient assessment. It strengthens the local anatomical component of treatment planning. The application site may be selected through the combined consideration of symptoms, tissue involvement, palpation and verified anatomy rather than by tenderness alone. Previous clinical studies have reported improvement in pain, tenderness and functional scores after *Agni-Karma*. Nevertheless, clinical effectiveness does not itself establish the safest point, temperature, exposure duration or depth. A sequential research programme is required, beginning with cadaveric mapping, followed by thermal-depth studies and ultimately controlled clinical trials using standardised points.[22]

PROPOSED CLINICAL TRANSLATION

After cadaveric validation, the following clinical approach may be evaluated:

- Confirm the diagnosis of lateral elbow tendinopathy.
- Exclude radial tunnel syndrome, instability, cervical radiculopathy and intra-articular pathology.
- Palpate the lateral epicondyle and common extensor origin.
- Avoid selecting points only because they are maximally tender.
- Restrict the treatment field to the anatomically validated common extensor region.
- Avoid deep, prolonged or repeated thermal application over the radial neck, radiocapitellar joint and posteroinferior ligament complex.
- Use the minimum controlled thermal exposure required to produce the intended superficial response.
- Document the point pattern, instrument, duration, immediate skin response and adverse effects.
- Perform the procedure only under institutional protocols and by trained practitioners.

STRENGTHS OF THE PROPOSED STUDY

- It integrates surface anatomy with direct deep dissection.
- It examines tendons, ligaments, joint structures and nerves together.
- It evaluates the effect of forearm rotation.
- It provides a reproducible coordinate-based method.
- It may improve standardisation of future clinical trials.
- It avoids dependence on tenderness alone.
- It develops a clear safe, caution and avoid classification.

LIMITATIONS

- Embalming may alter tissue thickness and nerve position.
- Cadaveric measurements may differ from living subjects because of muscle tone and circulation.
- Elderly cadavers may not represent younger athletic individuals.
- Cadaveric mapping cannot determine clinical effectiveness.
- Anatomical safety does not alone establish a safe temperature or application duration.
- Superficial sensory nerve branches may show substantial individual variation.

- The classification cannot be considered absolute because no anatomical region is completely free from individual variation.
- Results from a small number of specimens may have limited generalisability.
- Clinical translation may require confirmation by ultrasound in living participants.

FUTURE SCOPE

- Ultrasound validation of the cadaverically defined points in healthy volunteers.
- Thermographic assessment of heat distribution during *Agni-Karma*.
- Histological study of controlled thermal penetration at different exposure durations.
- Development of an ultrasound-guided point-selection method.
- Comparative clinical study between tenderness-based and anatomy-based point selection.
- Standardisation of instrument tip, temperature, duration and number of points.
- Evaluation of clinical outcomes through pain score, grip strength and Patient-Rated Tennis Elbow Evaluation.
- Preparation of a three-dimensional digital model of the lateral elbow.

CONCLUSION

The lateral elbow is an anatomically complex region in which the common extensor tendon, extensor carpi radialis brevis, joint capsule, lateral ligament complex, radial nerve and posterior interosseous nerve are closely related. Selection of *Agni-Karma* sites according to tenderness alone may not reliably identify the diseased tendon and may allow treatment points to extend towards the radial tunnel, joint or ligamentous structures. A coordinate-based cadaveric study can define the surface projection, tissue depth and neurovascular relationships of proposed treatment points. The area immediately related to the common extensor origin is likely to form the principal candidate zone, whereas anterior, distal and posteroinferior extensions require greater caution. Final safe-zone recommendations should be made only after specimen-wise measurements are completed. Cadaveric mapping can provide a scientific anatomical foundation for standardising *Agni-Karma* in tennis elbow. It should be followed by thermal-depth validation and carefully designed clinical trials before the map is adopted as a universal clinical protocol.

ETHICAL CONSIDERATIONS

The study was initiated only after approval from the Institutional Ethics Committee and the institutional body-donation or cadaveric research authority. All specimens were obtained through a legally approved body-donation programme. Confidentiality and dignity of the donated bodies was maintained throughout the study. No identifying information was included in photographs or publications.

DECLARATION OF HUMAN CADAVERIC MATERIAL

The authors declare that all cadaveric specimens were obtained and used according to institutional regulations, applicable legislation and the ethical principles governing anatomical donation and research.

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REFERENCES

1. Sanders TL Jr, Maradit Kremers H, Bryan AJ, Ransom JE, Smith J, Morrey BF. The epidemiology and health care burden of tennis elbow: a population-based study. Am J Sports Med. 2015;43(5):1066-1071. doi:10.1177/0363546514568087.
2. Nirschl RP, Ashman ES. Elbow tendinopathy: tennis elbow. Clin Sports Med. 2003;22(4):813-836. doi:10.1016/S0278-5919(03)00051-6.
3. Kraushaar BS, Nirschl RP. Tendinosis of the elbow: clinical features and findings of histological, immunohistochemical and electron microscopy studies. J Bone Joint Surg Am. 1999;81(2):259-278.
4. Zoner CS, Buck FM, Cardoso FN, Gheno R, Trudell DJ, Randall TD, et al. Detailed MRI-anatomic study of the lateral epicondyle of the elbow and its tendinous and ligamentous attachments in cadavers. AJR Am J Roentgenol. 2010;195(3):629-636.
5. Bernholt DL, Rosenberg SI, Brady AW, Storaci HW, Viola RW, Hackett TR. Quantitative and qualitative analyses of the lateral ligamentous complex and extensor tendon origins of the elbow: an anatomic study. Orthop J Sports Med. 2020;8(11):2325967120961373. doi:10.1177/2325967120961373.

6. Nimura A, Fujishiro H, Wakabayashi Y, Imatani J, Sugaya H, Akita K. Joint capsule attachment to the extensor carpi radialis brevis origin: an anatomical study with possible implications regarding the etiology of lateral epicondylitis. J Hand Surg Am. 2014;39(2):219-225. doi:10.1016/j.jhsa.2013.11.036.
7. Prasartritha T, Liupolvanish P, Rojanakit A. A study of the posterior interosseous nerve and the radial tunnel in 30 Thai cadavers. J Hand Surg Am. 1993;18(1):107-112. doi:10.1016/0363-5023(93)90253-Y.
8. Arrigoni P, Cucchi D, Guerra E, Marinelli A, Menon A, Randelli PS, et al. Distance of the posterior interosseous nerve from the radial head during elbow arthroscopy: an anatomical study. Joints. 2017;5(3):147-151.
9. Ozkan M, Bacakoğlu AK, Gül O, Ekin A, Mağden O. Anatomic study of the posterior interosseous nerve in the arcade of Frohse. J Shoulder Elbow Surg. 1999;8(6):617-620. doi:10.1016/S1058-2746(99)90100-3.
10. Sharma PV, editor and translator. *Sushruta Samhita* of *Sushruta*. Vol 1, *Sutra Sthana*, *Agni-Karma-Vidhi Adhyaya*. Varanasi: Chaukhambha Visvabharati; 2010.
11. Acharya YT, Acharya NR, editors. *Sushruta Samhita* of *Sushruta* with the *Nibandhasangraha* commentary of *Dalhana*. Varanasi: Chaukhambha Sanskrit Sansthan; 2010.
12. Mahanta V, Dudhamal TS, Gupta SK. Management of tennis elbow by *Agnikarma*. Ayu. 2013;34(1):45-47.
13. Sreelekshmi R, Raj S, Rajeshwari PN, Tripathy R. Comparing the efficacy of *Agnikarma* with therapeutic ultrasound in the management of tennis elbow: a randomised controlled preliminary study. J Ayurveda Integr Med. 2024;15(3):100898. doi:10.1016/j.jaim.2024.100898.
14. Cohen MS, Romeo AA, Hennigan SP, Gordon M. Lateral epicondylitis: anatomic relationships of the extensor tendon origins and implications for arthroscopic treatment. J Shoulder Elbow Surg. 2008;17(6):954-960. doi:10.1016/j.jse.2008.02.021.
15. Vergara-Amador E, Ramírez A. Anatomic study of the extensor carpi radialis brevis in its relation with the motor branch of the radial nerve. Orthop Traumatol Surg Res. 2015;101(8):909-912. doi:10.1016/j.otsr.2015.09.030.
16. Nirschl RP. Elbow tendinosis or tennis elbow. Clin Sports Med. 1992;11(4):851-870.
17. Hackl M, Wegmann K, Lappen S, Helf C, Burkhart KJ, Müller LP. The course of the posterior interosseous nerve in relation to the proximal radius: is there a reliable landmark? Injury. 2015;46(4):687-692. doi:10.1016/j.injury.2015.01.028.
18. Bonczar M, Ostrowski P, Dziedzic M, Kasprzyk M, Obuchowicz R, Koziej M. Evaluation of lateral epicondylopathy, posterior interosseous nerve compression and plica syndrome as co-existing causes of chronic tennis elbow. Int Orthop. 2023;47(7):1787-1795. doi:10.1007/s00264-023-05805-x.
19. Greenbaum B, Itamura J, Vangsness CT, Tibone J, Atkinson R. Extensor carpi radialis brevis: an anatomical analysis of its origin. J Bone Joint Surg Br. 1999;81(5):926-929. doi:10.1302/0301-620X.81B5.0810926.
20. Simone JP, Streubel PN, Sánchez-Sotelo J, Steinmann SP, Adams JE. Fingerbreadths rule in determining the safe zone of the radial nerve and posterior interosseous nerve for a lateral elbow approach: an anatomic study. J Am Acad Orthop Surg Glob Res Rev. 2019;3(2):e005.
21. O'Driscoll SW, Horii E, Morrey BF, Carmichael SW. Anatomy of the ulnar part of the lateral collateral ligament of the elbow. Clin Anat. 1992;5(4):296-303. doi:10.1002/ca.980050406.
22. Senan LC, Raj S, Tripathy R. Open-label clinical study to compare the effect of *Agnikarma* as a stand-alone treatment versus its association with the *Snayugatavata* treatment protocol in tennis elbow. Ayu. 2023;44(2):73-82.