

Morphometric Comparison of Distal Hamate Articular Surface with the Proximal Articular Surface of Middle Phalanges of Index, Middle, Ring and Little Fingers for Hemi-Hamate Arthroplasty

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Abstract

Introduction: The study is focused to compare the Distal Hamate articular Surface to the morphology of the base of middle phalanges of Index, Middle, Ring and little fingers.

Methodology: A Observational Paired T study was conducted. Patients with fractures of forearm or hand excluding any fractures in hamate and middle phalanges of Index , Middle, Ring & Little finger of both the upper limbs are subjected to Computed Tomography (CT) of hand and a 3D reconstructed image is obtained. Once the scans are collected, the below parameters will be determined using Radiant software.

	Hamate	Index Finger	Middle Finger	Ring Finger	Little Finger
Axial Ridge Angle					
Sagittal Inclination					
Articular Surface Area					

Results: At the end of this study ,we found that Majority of the patients who underwent CT Scans were noted to be between 31 and 50 years of age. Gender wise, males considered for the study were 24 (52%) and females were 25 (49%).

The average hamate axial ridge angle was 69.18 and that of the ring finger middle phalangeal base was 80.23 ($P < .05$)

Out of 50 patients the axial ridge angle of hamate was comparable with ring finger middle phalangeal base.

The average distal hamate surface area was 1.04 and that of the middle phalangeal base was 1.00 ($P < .05$)

The distal hamate articular surface area was comparable with the middle finger's middle phalangeal base.

The average sagittal inclination of distal hamate surface was 48.64 and that of the ring finger middle phalangeal base was 49.08 ($P < .05$).

The sagittal inclination of hamate was comparable with ring finger middle phalangeal base.

Conclusion: In literature very few radiological studies comparing the hamate and middle phalanx articular surfaces are reported. This study helps us in understanding the digit which is similar to hamate for undergoing Hemi Hamate Arthroplasty and usefulness of pre operative CT scan in further management of chronic proximal interphalangeal joint fracture dislocations.

According to the results obtained from our study, we conclude that the Axial ridge angle and sagittal inclination of Middle Phalanx of Ring finger is in close approximation with Hamate.

Articular Surface Area of Middle Finger is in close approximation with Hamate distal articular surface area.

Keywords: PIPJ- Proximal Interphalangeal Joint, ORIF- Open Reduction, Internal Fixation, CT- Computed Tomography, HHA- Hemi Hamate Arthroplasty

Introduction

Proximal interphalangeal joint fracture dislocations are notoriously difficult to manage. When the middle phalanx is dislocated dorsally, the volar articular surface is at a higher risk of fracture.

The incidence of proximal interphalangeal joint fracture dislocations has become a daunting task as the number of injuries recorded in sports medicine has increased [1-3].

Despite a lack of demographic studies, it has been estimated that dorsal fracture dislocations of the proximal interphalangeal joint occur at a rate of 9 per 100,000 people per year [4].

The prognosis following a PIP joint dislocation depends on the treating physician's ability to recognize the fracture pattern and evaluate the severity of the injury [5].

The treatment plan will change depending on the nature of the damage

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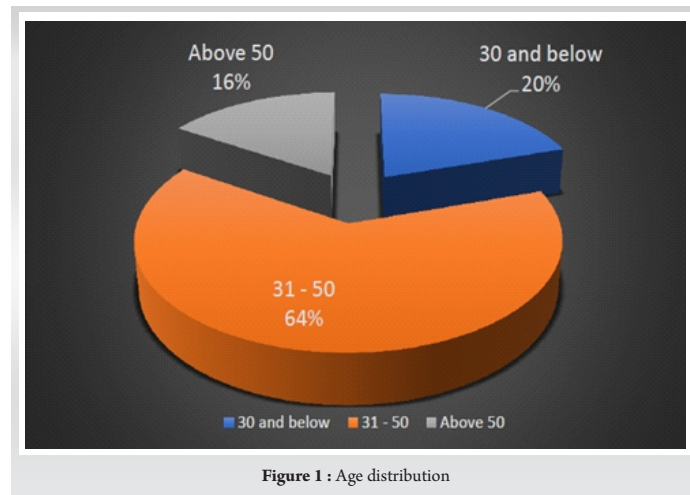
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and the individual patient. Avulsion or impaction shear are the two main processes that lead to PIPJ fracture-dislocations [6].

Injuries to the middle phalanx are classified as either volar directed fracture dislocations or dorsal directed fracture dislocations depending on the portion of articular surface involved. Third group is the pilon type of injury, in which both the volar and dorsal lips are involved.

As a rule, the size of the broken fragment is taken into account while deciding on a treatment plan. Non-invasive procedures, such as buddy taping, are preferable in cases with stable PIPJ fracture dislocation. Restoration of the articulating surface of middle phalanx is essential in order.

For fractures involving 30% to 50% of the articular surface, ORIF or volar plate arthroplasty has been considered as a treatment option.

TABLE 1 : AXIAL RIDGE ANGLE

ARTICULAR SURFACE OF BONE	AXIAL RIDGE ANGLE	P VALUE
HAMATE	69.18	
INDEX FINGER	69.75	HS
MIDDLE FINGER	69.95	HS
RING FINGER	69.5	HS
LITTLE FINGER	69.36	HS

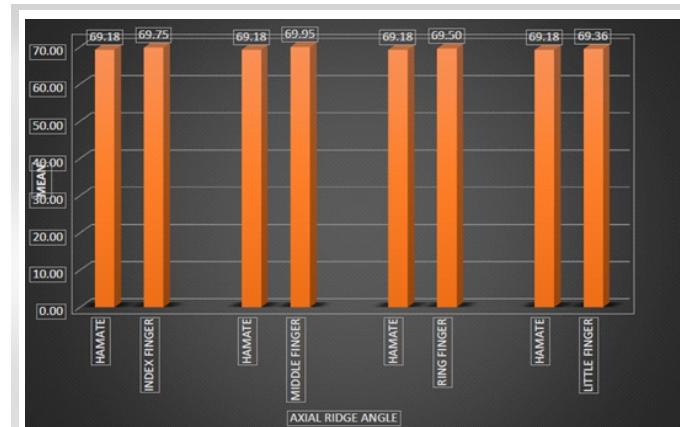
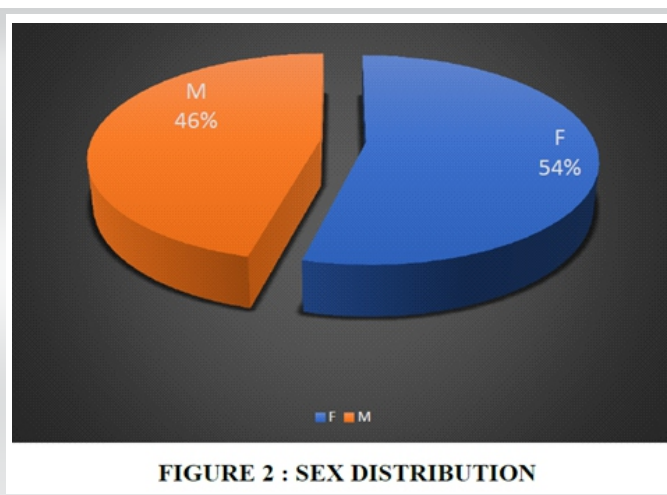


FIGURE 3: AXIAL RIDGE ANGLE



When more than half of the joint surface has been destroyed, reconstruction of joint congruency is desired. Volar plate arthroplasty is recommended for these patients, however it may lead to reduced motion and recurrent dorsal subluxation in cases of extensive comminution.

In order to successfully recreate the volar base, hemiarthroplasty may be the best option

Aim

The study is focused to compare the Distal Hamate articular Surface to the morphology of the base of middle phalanges of Index, Middle, Ring and little fingers.

Study Setting

This study will be done in the following hospitals in association with radiology department for accurate measurements of the included

TABLE 2: SURFACE AREA COMPARISON

	ARTICULAR SURFACE AREA	P VALUE
HAMATE	1.04	0.000
INDEX FINGER	0.72	0.000
MIDDLE	1.00	0.003
LITTLE	0.83	0.000
RING FINGER	0.57	0.000

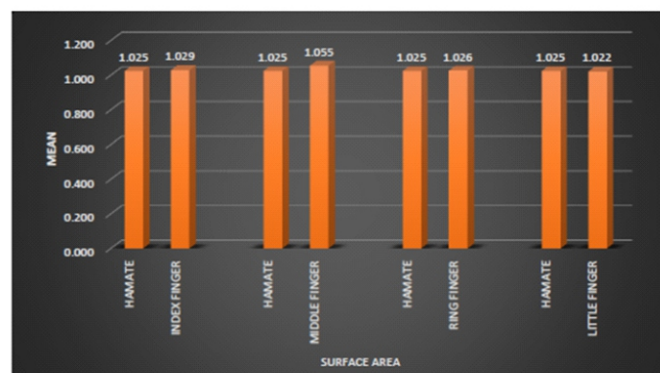


FIGURE 4: SURFACE AREA

variables.

1. KMC Hospital, Attavara, Mangalore.
2. KMC Hospital, Ambedkar-circle, Mangalore.
3. Wenlock district government hospital, Mangalore.

Study Design

The study design used is Time bound Study since the incidence of getting CT scans of hands which include images of middle phalanges of index, middle, ring, little fingers and carpal bones is less.

Study Participants

Patients without fractures in hamate and middle phalanges of Index, Middle, Ring & Little finger of both the upper limbs.

Inclusion criteria:

- Patient aged >18 years.
- CT scans of wrist and hand without pathology in hamate and middle phalanges.

Exclusion criteria:

- Contained any visible acute or chronic osseous deformity of the hamate and phalanges.
- Incomplete series in the axial, coronal, and sagittal planes.
- Arthritic changes in the bones of hand and wrist.

Study Duration

After ethics committee approval on October 2020 till September 2022.

TABLE 3: SAGITTAL INCLINATION COMPARISON

	SAGITTAL INCLINATION	P VALUE
HAMATE	48.64	0.000
INDEX FINGER	50.53	0.000
MIDDLE FINGER	52.50	0.000
RING FINGER	49.08	0.481
LITTLE FINGER	49.24	0.295

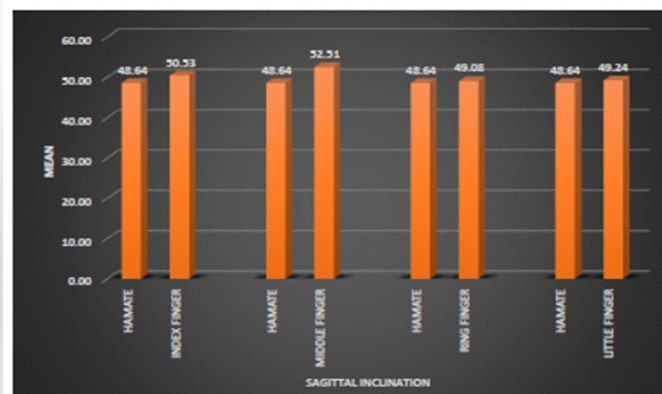


FIGURE 5: SAGITTAL INCLINATION COMPARISON

Sample Size

Time bound study includes the total number of CT scans collected from onset of ethical committee clearance till September 2022.

Sampling Method

Paired T test, $p < 0.05$ (Null hypothesis testing)

Method

After the scientific and ethics committee approval, patients who will be scheduled for CT scans after obtaining written informed consent will be included in the study. Once the scans are collected, the below parameters will be determined using Radiant software.

Imaging

Patients with fractures of forearm or hand excluding any fractures in hamate and middle phalanges of Index, Middle, Ring & Little finger of both the upper limbs are subjected to Computed Tomography (CT) of hand and a 3D reconstructed image is obtained for further analysis.

The patient is made to wear lead apron and only the CT hand with an already existing fracture that needs to be evaluated is taken. The CT scans are 3D

Results

We had selected 50 patients who had presented to our hospital in accordance with the selection criteria from the period of December 2020 till September 2022.

Age Distribution

Majority of the patients who underwent CT Scans were noted to be between 31 and 50 years of age. Gender wise, males considered for the study were 24 (52%) and females were 25 (49%).

Most of our cases were patients between 31 to 50 years of age. The youngest was 22 years old and the oldest was 75 years old. The mean age in this study group was 42 years.

Gender Distribution

In our study of 50 patients, equal sex distribution was observed with 23 males and 27 females

The average hamate axial ridge angle was 69.18 and that of the ring finger middle phalangeal base was 80.23 ($P < .05$)

Out of 50 patients the axial ridge angle of hamate was comparable with ring finger middle phalangeal base.

Surface Area

The average distal hamate surface area was 1.04 and that of the middle phalangeal base was 1.00 ($P < .05$)

Out of 50 patients the, distal hamate articular surface area was comparable with the middle finger's middle phalangeal base.

Sagittal Inclination

• The average sagittal inclination of distal hamate surface was 48.64 and that of the ring finger middle phalangeal base was 49.08 ($P < .05$).

• Out of 50 patients the sagittal inclination of hamate was comparable with ring finger middle phalangeal base.

Discussion

Proximal interphalangeal joint fractures management is a challenge, often resulting in suboptimal result. Long-term complications, such as stiffness, joint arthritis, and constant pain, have been linked to these fractures. The major objective is to achieve better reduction and begin early movement despite the fact that anatomic reduction of these fractures does not have outstanding clinical results [7].

They rely on the ligamentotaxis system, wherein little tissue tension mitigates fracture and diverts joint surfaces prior to full joint mobility.

We assessed and analyzed radiological boundaries in a study of 50 persons who had CT scans of their wrists and hands. We studied ridge angle, sagittal inclination and surface area of both hamate distal articular surface with middle phalangeal base articular surface region.

Both the hamate and the central phalanx have articular surfaces that are similar when seen in 3D modeling software. We found that the middle finger's surface area was similar to that of the hamate, and the ring finger's sagittal inclination, axial ridge angle were also similar to those of the hamate. To begin, our study population included 50 individuals. We used a paired T test with a null hypothesis.

There are a few limitations to our study that should be mentioned.

In any case, articular surface morphology varied greatly between the hamate and the phalanges; larger sample numbers collected from other

populations may shed some light on the extent of morphological variation at the volar MP base and the dorsal distal hamate [8-11].

The second limitation of our radiographic analysis is the lack of information about the presence or absence of significant degenerative or posttraumatic osteological alterations to the articular surfaces.

In addition, our study necessitates improved software for analyzing the geology of the central phalanx and the hamate articular surfaces.

Fragile separations of the PIP joint are best treated with hemi-hamate arthroplasty [12].

Conclusion

In literature very few radiological studies comparing the hamate and middle phalanx articular surfaces are reported. This study helps us in understanding the digit which is similar to hamate for undergoing Hemi Hamate Arthroplasty and usefulness of pre operative CT scan in further management of chronic proximal interphalangeal joint fracture dislocations.

According to the results obtained from our study, we conclude that the Axial ridge angle and sagittal inclination of Middle Phalanx of Ring finger is in close approximation with Hamate.

Articular Surface Area of Middle Finger is in close approximation with Hamate distal articular surface area.

Declaration of patient consent : The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

Conflict of Interest: None, **Source of Support:** None

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