Original Research Article

Reconstruction of ankylosed Proximal Interphalangeal Joint of a Finger Using Conchal Cartilage

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Abstract
Ankylosis of Proximal Interphalangeal Joint (PIPJ)of a finger can occur after intra-articular fractures, burns, degenerative conditions like rheumatoid arthritis. Not only are fingers with ankylosed PIP joints of little use for grip or grasp, but they are frequently injured because they do not follow the normal arc of the other fingers. An additional problem, though less so with the index finger, is the Quadriga effect, which can occur when profundus excursion is impaired with arthrodesis. Thus, ankylosis of Proximal Interphalangeal Joint of a finger in non-functional position can result in significant disability. Management of this problem varies from amputation to arthrodesis to arthroplasty. Many patients opt for arthroplasty as it improves range of motion and relieves pain. Proximal Interphalangeal Joint reconstruction has also been described using vascularised joint transfer and non vascularised autografts like perichondrium, costal cartilage. We report 4 cases of Proximal Interphalangeal Joint ankylosis which were reconstructed using non vascularised conchal cartilage. The ankylosed portion of the joint was excised. Raw surfaces on either side were covered with conchal cartilage grafts. The grafts were fixed with sutures. Joint stability was achieved with PL grafts which were sutured on either side to periosteum covering the dorsal and volar aspects of the cartilage grafts. We report here outcomes of the procedure with respect to pain, stability, range of motion and complications.

Keywords: Proximal interphalangeal joint ankylosis, conchal cartilage, arthroplasty.

Introduction
Ankylosis of Proximal Interphalangeal Joint (PIPJ) of a finger can occur after intra-articular fractures, burns, degenerative conditions like rheumatoid arthritis. Lack of mobility at proximal interphalangeal (PIP) joint significantly impairs grasp. Littler and colleagues described the Proximal Interphalangeal (PIP) Joint of a finger as the “functional locus of finger function.” Though full range of PIP Joint motion is not essential for hand function, an arc extending from 45 – 90 degrees can considerably improve hand function. Restoration of functional range of motion at PIPJ can be achieved using conventional methods like capsulotomy, collateral ligament release, check rein ligament release and volar plate release. Implant arthroplasty and vascularized joint transfer are other methods to...
restore range of motion at the joint. Interposition arthroplasty using non vascularised tissue like perichondrium\(^5\) and costal cartilage\(^6\) is also described. We present our experience with arthroplasty of PIP joint using non vascularised conchal cartilage.

**Material and Method**

It is a retrospective analysis of 4 patients in whom arthroplasty of a proximal interphalangeal joint of a finger was performed using conchal cartilage. Mean age of the patient was 23 years. 3 were males. In first 3 cases, primary treatment was carried out elsewhere and these patients came to us for further improvement in their stiff fingers. Case no 4 was primarily treated by us wherein abdominal flap was done to cover volar skin defect. Mean Time interval between primary surgery and arthroplasty was 6 months.

**Demographic Profile**

<table>
<thead>
<tr>
<th>Sr no</th>
<th>Age</th>
<th>Sex</th>
<th>Mechanism of injury</th>
<th>Range of motion at PIP Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>23</td>
<td>M</td>
<td>Injury while playing cricket</td>
<td>Flexion-10-15 degrees Extension lag of 10 degrees</td>
</tr>
<tr>
<td>Case 2</td>
<td>23</td>
<td>M</td>
<td>Fall of heavy object</td>
<td>No movement at PIP Joint</td>
</tr>
<tr>
<td>Case 3</td>
<td>20</td>
<td>F</td>
<td>Fall of heavy object</td>
<td>No movement at PIP Joint</td>
</tr>
<tr>
<td>Case 4</td>
<td>25</td>
<td>M</td>
<td>Hand trapped in machine while working</td>
<td>Flexion-10-15 degrees Extension lag of 5-10 degrees</td>
</tr>
</tbody>
</table>

**Clinical features and radiological findings were as follows**

<table>
<thead>
<tr>
<th>Sr no</th>
<th>Clinical features</th>
<th>Radiological findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>Fusiform swelling at the PIP joint with ulnar deviation of the index finger. An active flexion of 15 degrees and extension lag of 10 degrees was seen</td>
<td>Almost complete obliteration of joint space, widened head of PPx and base of MPx. Osteophytic changes could also be seen</td>
</tr>
<tr>
<td>Case 2</td>
<td>Stiff middle finger. Transverse scar on dorsum of PIP joint with no flexion and extension at the joint</td>
<td>Complete bony ankylosis of MF PIP Joint in mild hyperextension</td>
</tr>
</tbody>
</table>
Case 3 Flap on the dorsum of the middle finger and index finger. No movement was present at the PIP joint. Ulnar deviation and shortening was seen in both the fingers.

Case 4 Crush injury to right hand, treated earlier with abdominal flap for volar skin defect. Intraarticular fracture led to ankylosis of PIP Joint of middle finger.

Chronic osteomyelitic changes of PPx with ankylosis and ulnar deviation of PIP Joint

Bony ankylosis of PIP Joint

Surgical Technique
The proximal interphalangeal joint arthroplasty was performed using conchal cartilage after obtaining an informed consent from the patients. Dorsal incision was placed under regional anesthesia and tourniquet control. The PIP Joint was exposed after longitudinally splitting the central slip of extensor tendon. Part of collateral ligament and volar plate were detached from proximal phalanx.

Severe ankylosis PIP Joint

Release of ankylosis

The ankylosis was released using blunt and sharp dissection and the bone ends were brought in the wound.

The bone ends were debrided using fissure burr and contouring burr. Continuous saline irrigation was performed throughout the burring. Adequate gap of about 3-4 mm was created between distal end of PPX and proximal end of MPX. Subsequently conchal cartilage graft was harvested.
The harvested cartilage graft of size 6-7mm was placed on both bone ends and stabilized with Nylon 4-0 suture fixation after drilling holes in bone ends at 2, 4, 8 & 10° clock positions. Both bone ends receive cartilage grafts to itself and to surrounding periosteum at sufficient tension.

Both the cartilage grafts and the bone ends were covered with PL tendon graft circumferentially to achieve stability at PIPJ. The PL graft was sutured to itself and to surrounding periosteum at sufficient tension. If required, PL graft can be sutured at the site of collateral ligament on either side as neo-collateral ligament. Central slip is repaired with continuous 4-0 nylon suture. Post-operatively, the hand was immobilized in POP with PIPJ in 35-45 degree flexion for 3-4 weeks. Gentle active and passive mobilization is then begun. Patients were asked to report for regular follow-up visits. Clinical as well as radiographic examinations were done at the follow-up visits.

Results
Case 1 achieved range of motion of 10-80 degrees, absence of pain and correction of ulnar deviation. No complication were observed.
Case 2 achieved range of motion of 30-50 degrees and absence of pain. However superficial necrosis of dorsal skin was seen.

Case 3 regained range of motion of 30-40 degrees but she after a week reported with presence of pain and infection of the operated site which responded to higher antibiotics. The infection could be attributed to inadequate debridement of osteomyelitic bones. Case 4 had uneventful recovery. He recovered range of motion of 30-50 degrees without pain.
Postoperative Radiological findings

The PIP Joint space was well maintained. Though there was mild dorsal subluxation, range of motion was improved and there was no pain.

<table>
<thead>
<tr>
<th>Sr no</th>
<th>Range of motion</th>
<th>Pain</th>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>70-80 degrees</td>
<td>Absent</td>
<td>Uneventful recovery</td>
</tr>
<tr>
<td>Case 2</td>
<td>30-50 degrees</td>
<td>Absent</td>
<td>Superficial necrosis of dorsal skin</td>
</tr>
<tr>
<td>Case 3</td>
<td>30-40 degrees</td>
<td>Absent</td>
<td>Infection at operated site</td>
</tr>
<tr>
<td>Case 4</td>
<td>30-50 degrees</td>
<td>Absent</td>
<td>Uneventful recovery</td>
</tr>
</tbody>
</table>

Discussion

PIP Joint impairment can adversely affect hand function. Reconstruction of damaged PIP Joint is a challenging task. The alternatives available to improve range of motion at PIP Joint include implant arthroplasty and vascularised joint transfer. Proximal Interphalangeal Joint reconstruction has also been described using non vascularised autografts like perichondrium, costal cartilage.

We have earlier described use of vascularised conchal cartilage for reconstruction of temporomandibular joint ankylosis. We have applied same concept with few modifications for the use of conchal cartilage for reconstruction of PIP Joint.

Conchal cartilage arthroplasty is an inexpensive technique. Implant arthroplasty and vascular joint transfer are relatively costly. The range of motion achieved after conchal cartilage arthroplasty was 30-40 degrees similar to that seen in implant arthroplasty and vascular joint transfer. In systematic review by Yamamoto et al, the mean postoperative arc of motion of silicone implant with the volar approach were 58 degrees, which was greater than surface replacement implant with the dorsal approach at 51 degrees. These results are similar to results in our series. The surgical technique is easy and there is minimal donor morbidity. No microvascular expertise is required. Implant arthroplasty and vascularised joint transfer are technically demanding. Donor morbidity is comparatively more in vascular joint transfer and minimal in implant arthroplasty. Main complication of the conchal cartilage arthroplasty is possibly resorption of the conchal graft may occur though we haven’t been able to document it. Also shortening of the finger by 2-3 mm should be explained to the patient as we need to freshen the bone ends. The procedure can be done for only 2 fingers as there is limitation to the amount of conchal cartilage that can be harvested from both the ears. Also in this series we have done it for index and middle fingers. Classically fusion is advised for injured PIP Joints of Index and middle finger. But patients in our series opted for reconstruction of PIP Joint over fusion. It needs to be seen how grasp of hand improves if it is done for ring and little fingers. Also as it is a non vascularised cartilage, its growth potential and hence its use in children cannot be expected. Implant arthroplasty is associated with complications like allergy, infection and implant failure. Complication of flap failure may be seen...
in vascularised joint transfer as it involves vascular anastomosis. Main indication for vascularised joint transfer is children with PIP Joint ankylosis as it has growth potential in addition to providing a new joint.\(^\text{11}\)

**Conclusion**

Results of conchal cartilage surface replacement arthroplasty for ankylosis of proximal interphalangeal joint of finger are comparable to other methods of joint reconstruction. Further studies are required to assess the long term utility of this procedure.

**Conflict of interest** - None

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**References**


