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RESTORING THE FUNCTION IN CAMPTODACTYLY: A FOCUS ON DISTRIBUTION, PATHOANATOMY AND STEPWISE SURGICAL APPROACH.

Plastic Surgery

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ABSTRACT

Introduction: Camptodactyly is a congenital flexion contracture of the proximal interphalangeal joints of the fingers, with an incidence of 1% . Despite various management strategies, achieving full functional restoration remains challenging. This study aims to evaluate the pathoanatomic structures involved in camptodactyly and assess the outcomes of a stepwise surgical approach to restore full passive extension. **Methods:** A retrospective review of 12 patients (5 males, 7 females) who underwent surgical treatment for camptodactyly at our institution between May 2022 and April 2023 was conducted. Inclusion criteria were patients with progressive flexion contractures greater than 30° and impaired function, simple or complex, from childhood to adolescence. A stepwise surgical technique was implemented, including skin and soft tissue release, flexor tendon tenotomy, volar plate release, and K-wire fixation. Postoperative management involved immobilization, scar massage, and passive motion therapy. **Results:** Of the 12 patients, 7 had simple camptodactyly and 5 had complex camptodactyly, with Windblown hand deformity and Arthrogryposis congenita. Surgical interventions led to significant improvements in flexion contracture, from a preoperative range of 30–90° to 0–40° postoperatively. Range of motion improved from 0–60° preoperatively to 50–90° postoperatively. Complications included soft tissue infections, skin graft loss, and digit stiffness, all managed with appropriate interventions. **Conclusion:** Camptodactyly, particularly with deformities greater than 30°, requires a comprehensive approach involving careful clinical evaluation, radiological investigation, and stepwise surgical correction. Complex cases, often presenting with bilateral involvement and deeper anatomical involvement, demand more intricate interventions. Further studies with longer follow-up are needed to refine treatment strategies and assess long-term outcomes

KEYWORDS

INTRODUCTION:

Camptodactyly refers to congenital flexion contracture of proximal interphalangeal joints of fingers with 1% of incidence{1}. Contracture of varying degrees which may be unilateral or bilateral presenting in early life or adolescence{2-5}. It may be simple or complex, if associated with other deformity/syndromes.

It's quite a challenging condition that can significantly impact hand function and aesthetics. several pathoanatomic structures like skin, subcutaneous fascia,flexor tendons, lumbicals, volar plate, collateral ligament, extensor appartus {6,7}have been implicated in the pathogenesis .Inspite of various mode of management available including operative and nonoperative methods , attaining full function of fingers is questionable.

Our study focussed on patients presenting with simple or complex camptodactyly in our insitute to evaluate the pathoanatomic structures involved and to assess the stepwise surgical technique and post operative techniques which helps to attains full passive extension of involved digits

METHODS:

It's a retrospective study , with Study period involving from may 2023 to July 2024

Inclusion Criteria:

1. Patients with camptodactyly operated in our institution between may 2022 and april 2023.
2. Both simple and complex camptodactyly patients
3. Both childhood and Adolescence patients
4. Patient operated with Camptodactyly with progressive flexion contractures of >30degrees and impaired function.

Exclusion Criteria:

1. Patient on conservative management with flexion contracture < 30 degrees
2. Acquired flexion contracture of proximal interphalangeal joint of fingers.

Preoperative And Postoperative Assessment:

Each finger was examined clinically for active range of motion at all joints and extension lag preoperatively and postoperatively by operating team.

Preoperative clinical assessment {8} focussed on

1. Presence of skin pterygium.
2. Presence of flexion deformity with Metacarpophalangeal joint extended and flexed.
3. Bouvier blocking maneuver – to assess the Proximal interphalangeal joint extensor lag due to central slip attenuation
4. Presence of Boutonniere deformity .

These clinical examinations corresponds to a step in the surgical treatment.

Radiological investigation:{9} x-ray of involved hand taken to look for

i) Proximal phalanx head Degeneration and Flattening / Beaking
ii) Volar subluxation of middle phalanx

Surgical Technique:{10}

Step:1

Skin Incision – Transverse proximal interphalangeal volar incision incorporating axial pattern Joshi transposition flap / midvolar longitudinal incision broken by multiple Z plasties. It helps to release the pterygium of skin and soft tissues.

Step :2

Release the fascia and subcutaneous tissue. care should be taken to preserve the both neurovascular bundle.

Step:3

Open the flexor sheath at the level of A3 pulley and retract Flexor digitorum profundus tendon , and divide the both slips of flexor digitorum superficialis transversely at the level of camper chiasm. If this step doesn't correct the deformity , then proceed to next step.

Step:4

Release the volar plate transversely as proximal as possible at checkrein ligaments and this allow the volar plate to slide forward distally. If needed minimally take down the collateral ligament and lumbricals .

Step:5

If needed , based on Bouvier maneuver preoperatively, Mild extensor lag – managed post operatively with proximal interphalangeal

extension blocking splint.

Major extensor lag – managed by intrinsic transfer of one slip of flexor digitorum superficialis tendon to lateral band

Step:6
If Boutonnierre deformity is present – corrected by Fowler's tenotomy.

After each step, full extension of finger was verified passively and stabilished using 0.8/1mm k wire if needed and then proceeded to next step if required. The skin defect was addressed using transposition flap, cross finger flap, split thickness skin graft, full thickness skin graft, distant flap like groin flap. The hand was immobilised using volar hand straight splint.

Post Op Management:
1. Hand was immobilised in volar straight splint for 3 weeks
2. Regular dressing done periodically and k wire was removed at 3 week.
3. Active motion of fingers was done for 2 weeks along with soft tissue management including scar massage and night splints.
4. Followed by Passive motion of fingers was encouraged with night splints.

The patient was then followed at 1,3,6 month postoperatively and each visit range of motion of fingers and degree of flexion deformity was assessed.

RESULTS:
During the study period, a total of 12 patients including 5 Male patient(41.6%) and 7 female patient(58.3%) who underwent surgical correction for camptodactyly in our insititute were followed .

Among the 12 patients, 7 patients(58.3%) were presented with simple camptodactyly and about 5 patients were with complex camptodactyly .The most common deformity/ syndromes were ,3 patients with Windblown hand deformity(25%) and 2 patients with Arthrogryposis Congenita(16.6%) shown in Table 1

Table:1shows Distribution Of Simple And Complex Camptodactyly

S.NO	CAMPTODACTYLY	MALE	FEMALE	TOTAL
1.	SIMPLE	3	4	7 (58.3%)
2.	WINDBLOWN HAND DEFORMITY	2	1	3 (25%)
3.	ARTHROGRYPOSIS CONGENITA	1	1	2 (16.6%)

The Patients were present in both childhood and adolescence with majority of them in the Age group – 5 to 10 years (50%) shown in Table 2 with bilateral hand involvement represented in fig:1 and the more common digits involved in simple camptodactyly were Ring and Little finger and in complex syndactyly Index/Mid/Ring/Little fingers are equally involved represented in fig:2&3.

Table: 2 shows age distribution among patients with camptodactyly

S.NO	AGE	SIMPLE CAMPTODACTYLY	COMPLEX CAMPTODACTYLY	TOTAL
1.	LESS THAN 5 YEARS	0	3	3(25%)
2.	5- 10 YEARS	4	2	6(50%)
3.	11-15 YEARS	2	0	2(16.6%)
4.	16-20 YEARS	1	0	1(8.3%)

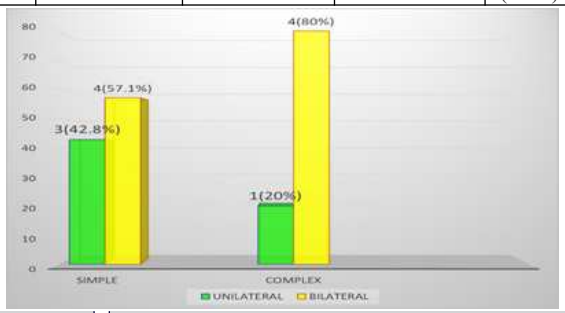


Fig: 1 shows Hand Invovement in simple and complex camptodactyly

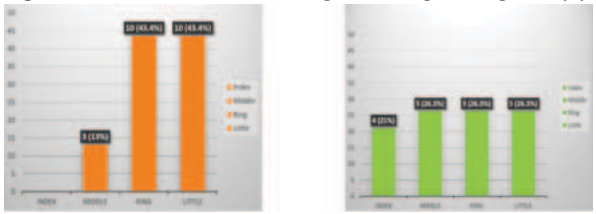


Fig : 2 shows Digits Involved simple camptodactyly. Total digits:23
Fig: 3 shows Digits invoved in complex camptodactyly. Total Digits:19

All pateints were operated for single hand (10 Right Hand and 2 Left Hand , Total – 12 hands) based on their hand dominance. All patients including simple and complex camptodactyly had skin and soft tissue release and cover in the form of flaps (Joshi flap / z plasty/groin flap/Cross finger flap) and skin graft. All had Flexor Digitorum Superficialis tenotomy , 14 had volar plate release , 6 had accessory collateral ligament release, 3 had lumbrical release and 30 digits had k wire stabilisation shown in Table 3. Only mild extensor lag in 22 digits of 6 patients by Bouvier's maneveur and all were managed conservatively post operatively with splints. No Boutonneire deformity found in all patients preoperatively.

Table :3 shows surgical procedures performed in simple and complex syndactyly

S.NO	SURGICAL PROCEDURES PERFORMED	SIMPLE TOTAL DIGITS : 23	COMPLEX TOTAL DIGITS : 19
1.	SKIN AND SOFTTISSUE RELEASE	23	19
2	FDS TENOTOMY	23	19
3	VOLAR PLATE RELEASE	6	8
4	ACCESSORY COLLATERAL LIGAMENT RELEASE	2	4
5	LUMBRICAL RELEASE	0	3
6	K WIRE FIXATION	16	14
7	LOCAL FLAPS (JOSHI FLAP/CROSS FINGER FLAP)	6	3
8	DISTANT FLAPS (GROIN FLAP)	1 (for 3 digits)	2 (for 4 digits each)
9	FTSG	1	1
10	SSG	7	3
11	Z PLASTY	6	4

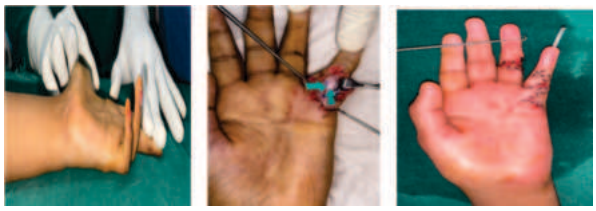
There was a significant improvement in flexion contracture of proximal interphalangeal joint from 30 – 90 degree (preoperatively) to 0 – 40 degree (post operatively) and the range of motion of proximal interphalangeal improved from 0-60 degrees (preoperatively) to 50 – 90 degree (post operatively) in both simple and complex camptodactyly shown in Table 4.

Table : 4 shows maximum contracture and range of motion among a digit involved in particular hand

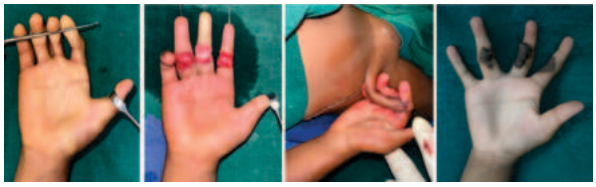
Case no	Type Of Camptodactyly	Hand operated	Digits involved	Preoperative PIPJ Flexion contracture(°)	Postoperative PIPJ Flexion contracture(°)	Preoperative PIPJ AROM(°)	Preoperative PIPJ AROM(°)
1	SIMPLE	RIGHT	R/L	45	15	60	90
2	SIMPLE	RIGHT	M/R/L	60	20	40	80
3	COMPLEX	RIGHT	I/M/R/L	90	40	0	50
4	SIMPLE	RIGHT	M/R/L	60	25	35	90
5	SIMPLE	RIGHT	M/R/L	30	5	60	80
6	COMPLEX	LEFT	M/R/L	55	20	30	60
7	COMPLEX	RIGHT	I/M/R/L	60	30	10	60
8	SIMPLE	LEFT	R/L	40	0	40	85
9	COMPLEX	RIGHT	I/M/R/L	80	30	30	75
10	COMPLEX	RIGHT	I/M/R/L	70	10	25	60
11	SIMPLE	RIGHT	M/R/L	40	5	40	85
12	SIMPLE	RIGHT	L	30	0	50	80

We had soft tissue infections in 3 digits , loss of skin graft in 2 digits and stiffness in 3 digits and all managed with antibiotics , regrafting and

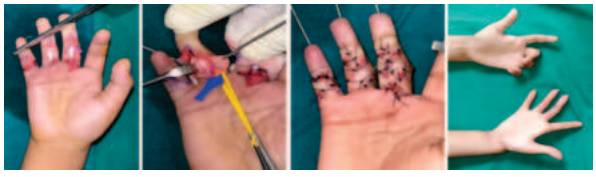
physiotherapy.



Case:1 Simple Camptodactyly Shows Fds Tenotomy With K Wire Stabilisation



Case:2 Complex Camptodactyly Shows Fds Tenotomy+volar Plate Release+accessory Collateral Ligament Release+k Wire+groin Flap



Case:3 Complex Camptodactyly With Abnormal Lumbrical Insertion

Case: Simple Camptodactyly With Volar Plate Release + Cross Finger Release

DISCUSSION:

Camptodactyly refers to congenital flexion contracture of proximal interphalangeal joints of fingers. It may be simple or complex associated with syndromes/ deformity. From our study the commonly associated deformity/ syndromes we seen were Windblown hand deformity and Arthrogryposis congenital which were diagnosed along with their facial signs and lower limb involvement.{11-14}

Benson et al.{15} stated that while patient who presented eariy with condition have an equal sex distribution , late – onset are mostly female but we found that patients seeking treatment in early childhood (with in 10 years) were mostly those with complex camptodactyly and female patients . Bilateral hand involvement were noted in all case of complex camptodactyly with almost equal involvement of index,mid,ring &little fingers. In simple camptodactyly, the digits commonly involved were ring & little fingers.

The most commonly affected anatomic structure were skin with soft tissue and flexor digitorum superficialis in both simple and complex camptodactyly. But involvement of deeper structures like volar plate, Accessory collateral ligament, lumbricals were commonly involved in complex camptodactyly. Preoperatively contracture and range of movements were severely affected in complex camptodactyly than simple.

The clinical, radiological and stepwise surgical approach helped us to identify the pathoanotomic structures involved in both simple and complex camptodactyly and also helped in preventing prolonged operative time. Inspite of all these techniques, we were not able to achieve full contracture correction with full range of movements which require further refinements.

Limitations of our study includes small study group and short study period, needs long term followup of patients operated in childhood to assess outcomes when they reach adolescence. Further genetical study needed to confirm the diagnosis of complex camptodactyly. Involvement of more radiological investigations like MRI which needs specially trained radiologist in musculoskeletal diagnosis.

CONCLUSION:

Camptodactyly whether simple or complex with deformity more than 30 degree needs tailored clinical, radiological and step wise surgical approach to achieve maximum functional and aesthetic outcomes. Complex camptodactyly presents with involvement of more number of anatomic structures and deformity with bilateral involvement .

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