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Original Article

Surgery Section

# Staged Management of Severe Postburn Contracture of Elbow and Knee- A Prospective Interventional Study

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## ABSTRACT

**Introduction:** Long-standing burns at major joints like the elbow and knee often lead to contractures, despite of best treatments and their management poses a great challenge owing to underlying contracted tendons, neurovascular bundle, and joint ligaments. Attempts at release and correction of contractures may lead to injury to the adjacent neurovascular structures.

**Aim:** To evaluate the effectiveness of staged release as a means of definitive treatment of severe burn contracture.

**Materials and Methods:** A prospective interventional study was conducted on 30 patients in the Department of Burns, Plastic and Reconstructive Surgery Srirama Chandra Bhanja Medical College and Hospital, Cuttack, Odisha, India, from December 2018 to December 2020. In the first stage, the maximum excisional release of contracture was done, avoiding any stretching of the neurovascular bundle, then bedside graded traction was applied at the joint until the complete release of contracture was observed. The resultant raw area was covered with a split-thickness skin graft in the second stage. The collected data included- site and side of the contracture, cause of initial burn, Improvement in flexion arc (in degrees), duration of splintage after surgical release, complications and Patient and Observer Scar Assessment Scale (POSAS). Paired t-tests were performed to analyse changes in preoperative versus postoperative measurements.

**Results:** Eighteen cases of knee contractures and 12 cases of elbow contractures were included in the study. Among the patients that were analysed, 17 were females and 13 were males, with a female-to-male ratio of 1.3:1. The age range was 18-50 years, with a mean age of 36±8.79 years. The mean Range of Motion (ROM) of elbow contracture with a severe degree of contracture improved from 25% of functional ROM to 124.29% at 6 months postoperatively. Similarly, the mean ROM of knee contracture with a severe degree of contracture improved from 25.76% of functional ROM to 102.58% at 6 months postoperatively. For both elbow and knee contracture cases the differences in mean ROM were statistically significant with all p-values <0.05. The average time at which the patients reported to the hospital, after developing contracture was 36.8 months, and it ranged from 24 months to 62 months. According to POSAS patient scale, the overall score was 6 and 5 for the elbow and knee, respectively and on the POSAS observer scale, overall score was 6 for both the elbow and knee, respectively.

**Conclusion:** The staged release procedure applied in the present study was an effective way of dealing with long-standing contractures with minimal complications.


**Keywords:** Physiotherapy technique, Range of motion, Scar, Splints, Tractions

## INTRODUCTION

Burn injury is still a common cause of trauma, especially in low and middle-income countries and the prevalence of postburn contractures is high in India but exact data can not be obtained as it varies considerably between studies [1]. The mortality and morbidity from burns have reduced tremendously over the past few decades, but the inevitable postburn scars, contractures, and other deformities collectively have aesthetic and functional considerations [2]. Joint contractures in severe burn patients can only be minimised by early rehabilitation, but not eliminated completely [3].

The management of deep burns around the elbow and knee joints presents a great challenge. Inadequate treatment and rehabilitation after deep burn injuries inevitably become complicated by debilitating contractures, that can severely compromise extremity functions and result in serious disability [4-7]. Methods used to treat these deformities and restore function have ranged from nonsurgical procedures such as splinting and serial casting in milder cases to multiple sessions of surgical release and reconstruction with various flaps like local transposition flap, propeller flap, pedicle flap, free flap or split-thickness skin graft in severe cases [4,5,7,8]. Nevertheless, all these methods either do not initially achieve full correction or have high recurrence rates because of unsatisfactory scar release limited by the contracted tendons, neurovascular bundle, and joint ligaments. Moreover, these severe deformities often cannot be corrected in a one-stage open surgical procedure because the skin and neurovascular structures may not tolerate acute stretching and lengthening [7].

In the previous studies, either non surgical skin traction methods were used for the treatment of these joint contractures or they were released surgically followed by immediate graft or flap cover [8-12]. However, in the present study a combination of both procedures was used to get a complete release. The aim of the present study was to evaluate the effectiveness of two-stage release (i.e., the excisional release of elbow/knee joint contracture with postoperative stretching and subsequent cover with a split-thickness skin graft) as a means of definitive treatment of severe burn contracture.

## MATERIALS AND METHODS

This prospective interventional study was conducted on 30 patients in the Department of Burns, Plastic and Reconstructive Surgery Srirama Chandra Bhanja Medical College and Hospital, Cuttack, Odisha, India, from December 2018 to December 2020. The study was approved by the Institutional Ethical Committee (IEC application No- 139).

**Inclusion criteria:** All the patients, with long-standing (more than two year old contracture) severe postburn contracture of elbow and knee with age group more than 10 years were included in the study.

**Exclusion criteria:** Patients with bony ankylosis or neurological deficit in the affected limb, severe disease/co-morbidities, including malignancy (Marjolin's ulcer) or infection of the affected limb were

excluded from the study. Patients with age group ≤10 years, as they were less cooperative and were more likely to develop pressure injuries due to graded traction with splint usage, were also excluded from the study.

## Study Procedure

A goniometer with a 360° head, calibrated to the International Standard of Measurements was used to measure the active Range of Motion (ROM) of the affected joints. Information about the nature and date of the injury, treatment history, previous surgical procedure, splinting during and after wound healing, and follow-up care were taken. The difference in the percentage of functional ROM preoperatively versus postoperatively was analysed. Functional ROM is defined as "the movement required by a joint, to naturally perform activities in daily life" [13,14] as opposed to normal ROM, which is the maximal ROM value of healthy individuals [15]. Functional ROM cut-off values were retrieved from Korp K et al., ROM values to enable comparisons [13].

Both elbow and knee contractures were classified with, (Ogawa R classification) [16] [Table/Fig-1] which is an anatomical classification for burn contractures depicting the extent of the scar [Table/Fig-2,3].

| Elbow and knee contractures classification |
|---|
| **Ogawa R classification for cubital fossa/elbow joint** |
| I Linear contracture of the cubital joint |
| I a flexor, radial, ulnar or dorsal surface |
| I b radial and ulnar surface |
| II Broadband contracture of the cubital joint |
| II a flexor, radial, ulnar or dorsal surface |
| II b radial and ulnar surface |
| III Broadband contracture extended to next surfaces |
| IV Contractures of entire circumferences |
| V Others |
| **Ogawa R classification for knee joint** |
| I Linear contracture on the knee joint |
| I a anterior, posterior, tibial or peroneal surface |
| I b tibial and peroneal surface |
| II Broadband contracture on the knee joint |
| II a anterior, posterior, tibial or peroneal surface |
| II b tibial and peroneal surface |
| III Broadband contracture extended to next surfaces |
| IV Broadband contracture of entire circumference |
| V Others |

**[Table/Fig-1]:** Ogawa R classification for elbow and knee joint.

| Anatomical classification | No. of cases |
|---|---|
| I | 0 |
| II | 2 |
| III | 9 |
| IV | 1 |

**[Table/Fig-2]:** Anatomical classification of elbow contractures (Ogawa R classification).

| Classification | No. of cases |
|---|---|
| I | 0 |
| II | 5 |
| III | 11 |
| IV | 2 |

**[Table/Fig-3]:** Anatomical classification of knee contractures (Ogawa R classification).

Patients were examined for:

1. Extent and maturity of the scar.
2. Presence of blister, raw area, ulceration, or scar breakdown, if any.
3. Degree of contracture.
4. Range of motion.
5. Condition of the proximal and distal joints.
6. Any associated deformity.

Postoperative scar assessment was done by the POSAS [17,18].

**Definitive procedure [19]:** The active ROM at each involved joint was measured using a manual goniometer with a standardised technique. Extension and flexion planes of motion were recorded before the surgery for the elbow and knee joints [20,21]. A trial of preoperative physiotherapy for four weeks was required to compensate for the long-term immobilisation, which the patient does at his/her home. On the day of admission, traction was applied across the joint in a graded manner, to precondition the joint for the future process of release, ascertain the patient's compliance and habituate the patient's attendants to the future procedure. A custom-made turnbuckle splint was used to extend the elbow joint, and an ankle strap with weights attached was used for knee contracture extension. The weight traction used in the present study for knee contracture was 3-6 kgs in the form of bricks, each brick weighing 3 kg. Weight traction and elbow extension splint used, to be re-evaluated every 24 hours [12]. The weight was increased gradually as the patient's condition permitted. The steps taken were in stages:

**First stage**: Under anaesthesia and tourniquet control, excision of the scarred and contracted structures was done with fishtailing of the edges. At all stages, an insult to neurovascular structures due to direct trauma or over-stretching was avoided [Table/Fig-4,5]. The integrity of the vessels was ensured by releasing the tourniquet and palpating the distal arterial pulse. If the need arose, then the tendon lengthening procedure and joint capsule release and repair were done. Following release haemostasis was achieved and dressing of the wound was done. A Plaster of Paris (POP) splintage with cotton padding was given to keep the limb in a maximally extended position. The first dressing was changed on the 3rd postoperative day and a joint traction device was applied across the operated joint.

**[Table/Fig-4]:** Intraoperative surgical release of contracture.

Joint traction devices included weight traction with a rope and pulley system (dynamic splint) [Table/Fig-6] and a custom-moulded turnbuckle splint (static progressive splint) [Table/Fig-7] [12]. For elbow traction, a static progressive splint in the form of a custom-moulded turnbuckle splint was used, which provided a low load and gradual prolonged stretching. For the knee, weight traction with a rope and pulley system constituted of weights in the form of bricks tied to one end of the rope hanging from a pulley with the other end attached to a strap on the contracted limb. The weights of the bricks used were 3 kg.

The traction was evaluated every 24 hours and the load was increased gradually as the patient's condition permitted. Increasing load in the case of the elbow contracture comprised gradual progression in the splint angle and in the case of the knee consisted of adding weights to the pulley traction device. The added load at the maximal tolerable level was maintained by the splint, till the next session. A

**[Table/Fig-5]:** After the first stage of surgical release (Correction of contracture up to 70°). **[Table/Fig-6]:** Application of ankle straps with weight traction with one and half bricks by Rope and Pulley system. **[Table/Fig-7]:** Application of custom-moulded turn-buckle splint for gradual traction at the contracture site. (Images from left right)

**[Table/Fig-8]:** Appearance of regular healthy granulation tissue on the wound bed along with correction of flexion contracture. **[Table/Fig-9]:** Complete extension after 25 days of application splint. **[Table/Fig-10]:** Postoperative day 10 photograph showing good take of split-thickness skin graft. **[Table/Fig-11]:** Application of lightweight splintage during discharge to maintain the limb in an extended position. (Images from left to right)

measured progression in the traction load was made daily. Thus, graded traction was applied across the joint till a maximal release was achieved.

**Second stage:** By end of a few weeks maximal release of the contracture occurs and a healthy granulation tissue appears on the contracture release site. Subsequently, the patient was posted for surgery [Table/Fig-8,9]. A split-thickness skin graft was used to cover the raw area [Table/Fig-10]. The wound is dressed and a POP splintage with cotton padding was given to keep the limb in a maximal extension position. On the 10$^{th}$ day, the POP splint was replaced with a light weight-padded custom-moulded splint. Any postoperative complications were recorded.

The patients were later seen by a physiotherapist for splinting and mobilisation exercises. Postoperatively the joint needs to be splinted properly for a sufficient period i.e., six months otherwise there is a high chance of recurrence of contracture [Table/Fig-11]. Patients are also prescribed pressure garments to prevent scar hypertrophy. Pressure stockings or elastic-crepe bandages may be used as a means of pressure dressing. One month and six months postoperative patient follow-up were done and and contracture angle was recorded. The ROM of the operated joint(s) was measured using a goniometer. The postoperative result was assessed according to donor site morbidity, the cosmetic result of the recipient area and the resultant long-standing improvement. The presence of any complications was sought and recorded.

## STATISTICAL ANALYSIS

Paired t-tests were performed to analyse changes in preoperative versus postoperative measurements. Data were analysed using Statistical Package for Social Sciences (SPSS) statistics version 27.0 (IBM Corp.), with alpha at 5%.

## RESULTS

Among the patients that were analysed, 17 were females and 13 were males, with a female-to-male ratio of 1.3:1. The age range was 18-50 years, with a mean age of 36±8.79 years. Age-wise and gender-wise distribution for elbow contracture and knee contracture are summarised in [Table/Fig-12]. The most common cause of the initial burn injury was flame burns i.e., 27 (90%). Hot liquids

| Variables | Age (years) | Male | Female | Total |
|---|---|---|---|---|
| Elbow contracture | 15-20 | 1 | 1 | 2 |
| | 21-25 | 0 | 2 | 2 |
| | 26-30 | 1 | 0 | 1 |
| | 31-35 | 2 | 1 | 3 |
| | 36-40 | 1 | 3 | 4 |
| | 41-45 | 0 | 0 | 0 |
| | 46-50 | 0 | 0 | 0 |
| | Total | 5 | 7 | 12 |
| Knee contracture | 15-20 | 0 | 1 | 1 |
| | 21-25 | 3 | 0 | 3 |
| | 26-30 | 0 | 2 | 2 |
| | 31-35 | 2 | 2 | 4 |
| | 36-40 | 2 | 3 | 5 |
| | 41-45 | 0 | 1 | 1 |
| | 46-50 | 1 | 1 | 2 |
| | Total | 8 | 10 | 18 |

**[Table/Fig-12]:** Elbow and knee contracture-age/sex distribution.

affected 3 (10%) of the participants. 90% (27) of the participants had been treated in a hospital for the initial burn injury. The rest 10% were managed at home with oral medications and the application of ointments. No one had undergone any surgical procedure or splinting following the burn. And none of them was followed-up until the development of contracture.

Eighteen knee contractures and 12 elbow contractures were examined in the present study. Sixteen cases were present on the left-side (elbow-nine, knee-seven), 11 were on the right (elbow-three, knee-eight) and three cases were on both sides (knee-three) [Table/Fig-13,14]. Out of the 30, 16 cases presented between 2-3 years period (elbow-six, knee-10), 11 cases between >3 years to 4 years (elbow-four, knee-seven) and three cases between >4 years to 5 years (elbow-two, knee-one) [Table/Fig-15].

Two cases of knee contracture had the presence of a long-standing ulcer at the popliteal region, but the biopsy taken from the site did not reveal any evidence of malignancy. Proximal and distal joints in all the cases were soft and supple with no associated bony

**[Table/Fig-13]:** Preoperative photograph showing flexion contracture of 90°.

**[Table/Fig-14]:** Preoperative photograph showing flexion contracture of 90°.

| Duration of contractures | Elbow contracture | Knee contracture | Total |
|---|---|---|---|
| 2-3 years | 6 | 10 | 16 |
| >3-4 years | 4 | 7 | 11 |
| >4-5 years | 2 | 1 | 3 |

**[Table/Fig-15]:** Duration of the contracture.

deformities. Burn scar contracture severity values from Schneider JC et al., which arbitrarily defined mild, moderate and severe contractures based on the amount of motion at a joint were used to categorise the patients [22,23]. According to Schneider JC et al., classification, five elbow and 10 knee contracture cases fell into the moderate contracture category and seven elbow and eight knee contracture cases fell into the severe contracture category. For the elbow, functional ROM was taken as minimum 100° and maximum 151° and for the knee joint functional ROM was taken as minimum 131° and maximum 138° [24-26].

In elbow, preoperative mean ROM in the moderate contracture category was 68% of functional ROM (5, 16.81%). At one month and six months postoperatively, the mean ROM was 132% of functional ROM (7.58%). At both time intervals, differences were statistically significant with all p-values <0.05. The preoperative mean ROM in the severe contracture category was 25% of functional ROM (7, 11.55%). At one month and six months postoperatively, the mean ROM was 120% and 124.29%, respectively of functional ROM (8.16% and 10.58%). At both time intervals, differences were statistically significant with all p-values <0.05 [Table/Fig-16].

| Preoperative degree of contracture | No. of patients | Preoperative flexion arc (mean) (Preoperative ROM) | At one month postoperative flexion arc (mean) (postoperative ROM) | At six month postoperative flexion arc (mean) (postoperative ROM) |
|---|---|---|---|---|
| Mild contracture (93-140°) | - | - | - | - |
| Moderate contracture (46-92°) | 5 | 68 | 132 | 132 |
| Severe contracture (<45°) | 7 | 25 | 120 | 124.29 |

**[Table/Fig-16]:** Elbow-degree of contracture and functional outcome.

In knee, preoperative mean ROM in the moderate contracture category was 53.82% of functional ROM (10, 15.89%). At one month and six months postoperatively, the mean ROM was 106.11% of functional ROM (SD 2.11%). At both time intervals, differences were statistically significant with all p-values <0.001. The preoperative mean ROM in the severe contracture category was 25.76% of functional ROM (n=8, SD 9.16%). At one month and six months postoperatively, the mean ROM for both was 102.58% of functional ROM (SD 4.17% and 3.20%, respectively). At both time intervals, differences were statistically significant with all p-values <0.001 [Table/Fig-17].

| Preoperative degree of contracture | No. of patients | Preoperative flexion arc (mean) (Preoperative ROM) | At one month postoperative flexion arc (mean) (post-operative ROM) | At six month postoperative flexion arc (mean) postoperative ROM) |
|---|---|---|---|---|
| Mild contracture (100-150°) | - | - | - | - |
| Moderate contracture (50-99°) | 10 | 70.5 | 139 | 139 |
| Severe contracture (<50°) | 8 | 33.75 | 134.38 | 134.38 |

**[Table/Fig-17]:** Knee-degree of contracture and functional outcome.

The average time at which the patients reported to the hospital, after developing contracture was 36.8 months, and it ranged from 24 months to 62 months. [Table/Fig-18]. The degree of contracture most commonly reported in the case of elbow contracture came under severe category and that of knee contracture came under moderate contracture category [Table/Fig-16,17].

| Duration of contractures | Average time required for elbow contracture release (in days) | Average time required for knee contracture release (in days) |
|---|---|---|
| 2-3 years | 23.7 | 26.4 |
| >3-4 years | 28.7 | 30.5 |
| >4-5 years | 32 | 33 |

**[Table/Fig-18]:** Relation between the duration of contracture and the time required for the release.

The postoperative result was assessed according to donor site morbidity, the cosmetic result of the recipient area and the resultant long-standing improvement. None of the patients had donor site complications and all were satisfied with the cosmetic outcome. In two cases each of the elbow and knee contractures had complications of partial graft loss, which healed by bridging phenomenon and did not require regrafting. In one case, each of the elbow and knee contractures there were complications of recontracture after one month of discharge, which did not require re-surgery and improved with physiotherapy [Table/Fig-19]. According to POSAS patient scale, the overall score was 6 and 5 for the elbow and knee respectively and the POSAS observer scale overall score was 6 for both the elbow and knee, respectively.

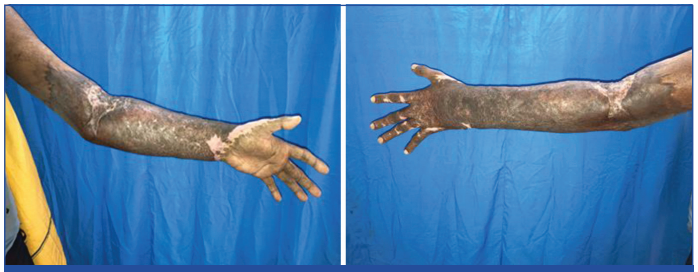
## DISCUSSION

The treatment of postburn knee and elbow flexion contractures has included non surgical and surgical methods. The non surgical method consists of passive stretching with physical modalities, joint mobilisation, traction and serial casting [27,28], these methods have two main drawbacks: the limited amount of corrective forces because of the skin's inability to tolerate direct pressure and the danger of knee subluxation [12,29]. Moreover, physical therapy needs experienced therapists and may fail in severe flexion contractures [28,30]. Hence, most of these contractures are ultimately treated surgically.

Surgical procedures increase the ROM and enhance function but complications like skin necrosis, tissue infection, subluxation, fracture, nerve palsy and recurrence may occur [12,30,31]. But if


**[Table/Fig-19]:** Photos showing complications. a) Partial graft loss in case of left elbow contracture; b) Partial graft loss in case of left elbow contracture; c) Recontracture in case of left side elbow contracture; d) Partial graft loss in case of left knee contracture; e) Partial graft loss in case of left knee contracture; f) Recontracture in case of right knee contracture.

**[Table/Fig-20]:** Six months postoperative photograph showing a well-settled graft and full extension at the knee joint bilaterally.



**[Table/Fig-21,22]:** Six months postoperative photograph showing epithelialisation of the raw area with full correction of contracture. (Images from left to right)

graded sustained traction is applied to a surgically released joint then the probability of these complications decreases, as there is gradual stretching of the contracted joint ligaments and tight neurovascular structures [32]. This concept of applying continuous, mild, and graded distraction force to achieve correction in surgically released postburn contracture joints forms the basis of the present study. The application of distraction apparatus in such cases allows a near-complete correction by fractional distraction [33].

Following the principle of slow distraction, we have used this two-stage release method in correcting severe long-standing elbow and knee contractures which helps in the early and complete correction of joint contractures and cuts down the number of procedures. Moreover, in a single staged release where due to contour deformity and irregular wound bed of the recipient area the graft take is often not predictable, this two-stage release technique provides a healthy regular surfaced wound bed without any cracks and crevices, as a result the graft take is good and reliable. And since a well-settled skin graft is achieved on a maximally stretched joint the chances of shearing of graft during the postoperative physiotherapy is minimal [33].

In present study, a good outcome is attained in almost all patients. Moreover, the results can be improved with a good selection of patients and adequate physiotherapy [Table/Fig-20-22]. Some of the surgical procedures used in the treatment of elbow and knee joint contractures are mentioned below. According to Baux S et al., linear contractures surrounded by normal skin require local flaps like Z-plasty [34] technique and others such as seven-flap plasty [35], running Y-V plasty [36], X-plasty [37] and the square flap method [38]. Fasciocutaneous, muscle or myocutaneous flaps are other options for contracture release. Yang JY of Taiwan in 1989 released elbow contracture with Reverse medial arm flap in 11 patients. Flap necrosis, ulnar nerve compression and insufficient flap size were a few limitations in an otherwise satisfactory flap [39]. The reverse lateral arm adipofascial flap, brachioradialis muscle flap, latissimus dorsi transposition flap, external oblique myocutaneous flap, thoracoepigastric flap and the ulnar artery flap are some of the diverse methods of muscle or fascial flap applications described for elbow contracture release [39-42]. Besides their donor site morbidity, and texture and colour mismatch, these flaps are usually considerably thick and may even impede elbow flexion.

De Lorenzi F et al., in the Netherlands presented their experience with free flap reconstruction in 39 burn patients and stated that it allowed the preservation of otherwise unsalvageable deep burns and secondary correction of contracted burn scars [32]. El-Khatib H in 1997 described an island fasciocutaneous flap based on the proximal perforators of the radial artery for resurfacing of the cubital fossa [40,41]. Besides their donor site morbidity, and texture and colour mismatch, these flaps are usually considerably thick and impede elbow flexion. The propeller flap was first introduced in 1991 by Hyakusoku H et al., in Tokyo, Japan. In their report, they presented only two cases: one for an elbow contracture and the other for an axillary contracture release with satisfactory results and no complications. For both cases, extensive skin grafting of the donor sites had to be done. The authors identified their flap as a complex of opposed double transposition flaps. They suggested that this flap could also be applied to other flexor regions such as the groin, popliteal fossa, and fingers where burn contractures are known to be common [43]. Kumar A and Behera M, in a study assessed the effectiveness of the static progressive knee orthosis for the reduction of knee flexion contracture by the device with a turnbuckle mechanism, which provided low load, gradual and prolonged stretching [44].

A publication from Korea and the Kleinert Institute advocated the correction of severe postburn hand deformities by using aggressive contracture releases and fasciocutaneous free-tissue transfers [45]. But the results achieved in many of these cases using this approach are less than optimal. Perforator plus fasciocutaneous flaps in the reconstruction of postburn flexion contractures of the knee joint has been studied by Gupta M et al., but all the cases were of 6-15 months duration, hence, complete release was possible. But in the present case, all cases were minimum of two years duration, so complete release of contracture was not possible

| Authors and year of study | Place of study | Number of subjects and site of contracture | Methodology | Complications | Inference |
|---|---|---|---|---|---|
| Suksathien R and Suksathien Y, 2010 [12] | Thailand | 10 knee, 3 elbow | Static progressive splint | No complication/recurrence | • Only one burn case in this study.<br>• Sample size small<br>• Range of Motion (ROM) less as they include trauma and infected cases |
| Bar-Meir E et al., 2006 [46] | Israel | 4 knee | Contracture release and latissimus dorsi free flap cover | Common peroneal nerve injury-1 case<br>Pin tract infection-2 cases | • Include microsurgery expertise<br>• Two team approach and time consuming<br>• Small sample size<br>• Done only in lower limbs<br>• Use of external fixator leads to additional complication |
| Herzenberg JE et al., 1994 [47] | Baltimore, United States | 14 knee | Iliazarov's external fixator | Recurrence-which the authors have termed "rebound" phenomena | • Done in lower limbs only<br>• No surgical release of contracture leads to rebound phenomena in 93% cases |
| Al-shaham AA, 2008 [33] | Malaysia | 36 knee | Similar to present study | 2 graft loss<br>3 recurrence | • The technique was only applied for knee joint<br>• No tendon lengthening procedure described |
| Present study, 2022 | Cuttack, India | 12 elbow<br>18 knee | As described in materials and methods | 4 graft loss<br>2 recurrence | • Includes both upper and lower limbs<br>• No secondary surgery needed |

**[Table/Fig-23]:** Comparison between various studies [12,33,46,47].

in a single surgery [10]. Outcomes achieved in the present study were found to be relatively better than various other similar type of studies [Table/Fig-23] [12,33,46,47].

### Limitation(s)

Small sample size, as it was conducted during Coronavirus Disease-2019 (COVID-19) pandemic period and cases were operated by different surgeons. Patients of the paediatric age group cannot be convinced of continuous stretching of joints.

## CONCLUSION(S)

Full surgical release of contracture is almost never possible in long-standing severe contractures without compromising the function of the joint, as there is a shortening of not only the muscles and tendons, but also the neurovascular bundle. This two-staged procedure is a technique of contracture release which incorporates surgical release followed by slow progressive stretching, thus, ensuring full correction without any serious complications.

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