Management of postburn flexion contracture of the proximal interphalangeal joint of the finger by distraction histiogenesis and release and skin grafting: A comparative study

ABSTRACT

Introduction: Flexion contractures of the fingers cause functional and esthetic problems to a burn patient. Various methods of reconstruction have been described, but the usual treatment for these contractures is release and split-skin graft. In this study, technique of distraction histiogenesis was used for the treatment of finger contracture.

Methods: In this study, sixty patients of postburn contracture of proximal interphalangeal (PIP) joint of the hand due to volar skin burns were taken. Thirty patients were treated with distraction technique and thirty patients with release and split-skin grafting. The average age of patient is 20 years.

Results: Both techniques showed improvement in range of motion at PIP joint. Esthetic result was also assessed using score on the Visual Analog Scale, with better score in distraction histiogenesis. There was no recurrence of contracture at 6 months follow-up.

Conclusion: Technique of gradual distraction histiogenesis is safe for treating long-standing flexion contracture of the finger without risk of neurovascular compromise to finger.

Keywords: Distraction histiogenesis, postburn contracture of the proximal interphalangeal joint, range of motion, release and split-skin graft

INTRODUCTION

Optimal hand function has a very positive impact on the quality of life of a postburn patient. Tredget[1] found that in patients with a mean total body surface area burn of 15%, 54% of patients sustained burns of the hand and upper extremity. In case of hand burns, flexion contractures are usually caused by a burn of volar digital skin. The most common sequel of burns to the fingers is the volar flexion contractures leading to functional impairment by disruption of flexion arc of the fingers and is also esthetically displeasing.

Acceptable treatment of these contractures is by release and split-skin graft (SSG), followed by prolonged immobilization and splintage.[2-4] Reconstruction of long-standing flexion deformity of the proximal interphalangeal (PIP) joint carries the risk of neurovascular compromise. Gradual soft-tissue distraction was used to treat, long-standing flexion contractures of the PIP joint, with a satisfactory result in some study.

In our study, finger contractures involving PIP joint region due to volar skin burns were taken. Two methods, distraction histiogenesis and release and SSG for the correction of
postburn contracture of PIP joint were compared. The results of these two techniques and their outcomes were assessed.

Aims
The aim of this study was to assess the functional and esthetic outcome of the two methods of correction. Functional outcome was measured by improvement in the range of motion (ROM), whereas esthetic outcome was measured by improvement in the score on the Visual Analog Scale (VAS) by the patient (1–10).

METHODS

This was a prospective study conducted in the tertiary care burn hospital in 2 years from December 2011 to October 2013. A total of sixty fingers with postburn contracture of the PIP joint of the hand were taken and divided into two groups according to the method of treatment received (Group 1: distraction histiogenesis and Group 2: release and SSG), randomly using a closed envelope method. Each group was assigned thirty fingers. Bilateral or more than one finger involvement was present in ten patients. In future reference, each finger is referred as a case. The average age of the patient is 20 years, and the average duration of contracture is 2.35 years. The patients with evidence of involvement of the bone and or joint were excluded from the study. Both informed and written consent was obtained about the procedure. The preoperative average degree of contracture in the distraction group was 69.33 and in release and SSG group was 56.17 [Table 1].

Technique of distraction
This procedure was done under local anesthesia. Schanz pin was passed transversely in the lateral plane through the bones on either side of the contracted joint, and distractor was applied. Using the advantage of volar displacement of neurovascular bundle in flexion contracture of fingers along with preinsertion palpation of the digital artery was done to ensure avoidance of injury to neurovascular bundles while passing pins. Three Schanz pins of size 1.5 mm were used; two on the proximal side and one on distal side of involved joint to maintain the alignment of the pins in one plane. The adequate distance was maintained across the joint to ensure that the distraction forces could be applied to straighten the joint [Figure 1]. After 1 week of applying the distractor, distraction started at the rate of 0.5 mm twice daily till the joint got straightened to the neutral position, which takes about 1–2 weeks depending on the severity of contracture. The distractor was maintained in place for 4 weeks after achieving the required result before its removal. Thereafter, distractor was removed. No extensor tendon injury resulting in extensor lag noted in any patient.

The technique of release and skin grafting involves the incisional release of the contracture band, followed by resurfacing of raw area with split-thickness skin graft harvested from the back of the thigh and immobilization of the joint with K-wire for 4 weeks.

In both techniques, after immobilization, physiotherapy and splintage started. Follow-up started 6–7 weeks after the distractor applied and 4 weeks after the release and skin grafting. Patients were subsequently followed up for up to 6 months for splintage review, physiotherapy, and assessment of functional and esthetic improvement.

RESULTS

Soft-tissue distraction and release and skin cover, the two methods, were used to correct the postburn flexion contracture of the PIP joint of the hand. Once the correction was achieved with no extensor lag, patients underwent physiotherapy and splintage [Figures 2-4]. At the end of 6 months follow-up, comparison of the active ROM and

| Group                | Preoperative degree of contracture (measured with goniometer) in range | Preoperative average degree of contracture | Preoperative average ROM |
|----------------------|------------------------------------------------------------------------|-------------------------------------------|--------------------------|
| Distraction          | 30-90                                                                  | 69.33                                     | 28.66                    |
| Release and SSG      | 25-90                                                                  | 56.17                                     | 37.5                     |

SSG: Split-skin graft; ROM: Range of motion

Figure 1: Distractor applied, three pins used, equal distance on either side of proximal interphalangeal joint maintained
esthetice outcome was done. Change in ROM and esthetic outcome were analyzed using the paired t-test. The assessment of improvement in ROM of both methods after 6 months showed that mean active range of movement had increased by 25.5° from 28.66° to 54.16° in distraction group and 29.5° from 37.66° to 67.16° in release and SSG group as compared to preoperative value. Improvement in ROM seen in both groups was statistically insignificant [Table 2].

The result of distraction histiogenesis group is cosmetically better as compared to the release and SSG group. Improvement in average esthetic score on VAS by patients seen in Group 1 is more than the improvement seen in Group 2 with P = 0.0002 which is statistically significant [Table 3].

**DISCUSSION**

Flexion contractures of the fingers cause functional and esthetic problems to a burn patient. Various methods of reconstruction have been described in the literature. Among those, release of the contracture and split-skin grafting is the simplest and most common technique. The development of external skeletal fixation dates from the middle of the 19th century when Malgaigne constructed an apparatus that was directly attached to the bone, thereby allowing the direct transmission of a mechanical force to the skeleton. At the turn of the 20th century, Codivilla performed the first limb lengthening using external skeletal traction after an oblique osteotomy of the femur. A significant contribution in the development of distraction osteogenesis was made by the Russian surgeon Ilizarov. A new application of Ilizarov external fixator was used to correct postburn contracture deformity of the wrist joint, by soft-tissue distraction histiogenesis.

Gradual soft-tissue distraction (distraction histiogenesis) was used to treat 12 fingers with long-standing flexion contractures of the PIP joint without the need for other reconstructive procedures. Soft-tissue distraction used for many conditions such as postburn contractures of the hand and wrist, PIP joint contractures in leprosy, burn, trauma, and congenital (camptodactyly). Our study compared two methods of correction, distraction and release and SSG. No study has been found in literature, comparing the improvement in ROM between distraction histiogenesis and release and SSG. Our study showed almost equal improvement in ROM in both groups with follow-up of 6 months. The results are comparable with previous study results shown below.

In a study for PIP joint contracture correction by distraction method, improvement in ROM was 63°, in which follow-up period to assess the ROM at PIP joint was of longer duration (1-4 years) than in the present study.
Another study showed improvement of 42° (range, 0°–80°), with a mean follow-up of 21 (range: 12–50) months. In Ravishanker’s study, the result in adults who had presented for the treatment for functional purposes was excellent.

In our study, the esthetic outcome (patient satisfaction) was also assessed and compared using score on VAS between the two groups. The result of distraction histiogenesis group is cosmetically better as compared to release and SSG group. This was not taken into account in any other study.

This may be due to the fact that gradual stretching of normal contracted skin in distraction histiogenesis group, without any incision and grafting provide the supple and uniform color of stretched skin as compared to surrounding normal skin. In our study, there was no recurrence of contracture at 6 months follow-up in both the groups.

Complications in our study were pin-track infection and loosening of pin in three patients (10%) and were managed conservatively. Loosening of pin was encountered during the maintenance of distractor in the neutral position, which was removed and the finger was splinted. Temporary flexion deformity of the distal interphalangeal (DIP) joint in the earlier patients with distractor group was managed with physiotherapy, and in other cases, finger splint was used, and ever since the application of distractor at DIP joint to prevent the temporary flexion deformity of the DIP joint was started, the outcome has been fine.

CONCLUSION

The procedure of distraction histiogenesis is a simple technique for treating long-standing flexion deformities of the PIP joint with avoidance of risk of neurovascular compromise to finger, limitation in the magnitude of release and donor scar related to release, and SSG with almost equal improvement in ROM. It is safe in patients with hemophilia and bony disorder such as melorheostosis. The result of distraction histiogenesis was cosmetically better.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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