Original Article

Effectiveness of 60 Degree Z-Plasty Incision in Treating Flexion Contracture of Fingers

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Abstract

Objective: To determine the effectiveness of 60 degree Z-plasty incision in treating flexion contracture of fingers.

Methodology: With approval from the institution's research committee and ethical board, this series study was carried out at the Burn and Plastic Surgery Centre, Hayatabad in Peshawar, Pakistan, from October 2023 to March 2025. The study included all patients who met the inclusion criteria, such as having digital contracture following burns, but excluded those with Dupuytren's contracture, tophaceous gout, skin conditions, or any pathological joint illness.

Through non-probability sequential sampling, information on 289 patients with mean age 37.96±12.32 years, ranging from 18 to 60 years including both gender were obtained. Variables were gathered in a Microsoft Excel sheet along with the pertinent patient data that was retrieved from the patient after informed consent. Statistics were examined using SPSS 26.

Results: The participants were categorized into age groups, with 46.0% of participants falling within the 18 to 35 age range, 33.6% between 36 and 50 years, and 20.4% between 51 and 60 years. According to gender distribution, 47.8% of participants were women and 52.2% of participants were men. The pre-operative extension lag at the PIP joint was recorded for each patient, with values ranging from 30 degrees to 60 degrees. The mean preoperative angle was 44.80±8.92 degrees.

Regarding the post-operative angle at the PIP joint, the data showed that a significant portion of the patients (72.3%) had mild contractures with an angle of < 10 degrees, indicating a successful reduction in flexion contracture following the surgery. The remaining 27.7% of patients presented with a moderate contracture (angle > 10 degrees).

Conclusion: 60-degree Z-plasty was shown to be quite successful in treating mild flexion contractures of the fingers, with 72.3% of patients reporting positive results.

Keywords: 60 degree Z-Plasty, Digital contracture release, Plastic Surgery procedure, Surgical Flaps.

Introduction

In plastic and reconstructive surgery, z plasty is a frequently used interposition surgical method for scar revision. Z-plasty, formerly known as "converging triangular flaps," entails raising and transposing two equal and opposing transposition flaps along a common access.[1] Z-plasty transpositions are recommended for lengthening scars, releasing contractures, and improving scar cosmesis by altering the orientation of the scar.[2,3] The widely used 60 degree Z-plasty can increase 75 % increase in length.[4] One method frequently utilized for scar revision is the Z-plasty. Its capacity to position a revised scar in or parallel to a crease line or relaxed skin tension line is one of the factors that make it beneficial for scar revision.[5]

By making two flaps from three equal limbs and two same-degree angles, the Z-plasty procedure usually lengthens and rotates the scar.[2] Usually, the flaps are designed with angles between 30 and 75 degrees. Less than 30 degree angles can cause tip necrosis, while more than 75 degree angles produce difficult-to-rotate flaps that result in dog ears and more tension.[6] In fact, the issue of shortening is what dictates that 60 degrees is the maximum angle that may be employed; even if it were feasible for other reasons, shortenings above 75% could not be accepted.[7] Dávila[8] measured the lengthening effects using computer simulation software. Using ADINA software, Kitto examined the lengthening effects of various Z-plasty patterns on a non-linear elastic skin model.[9] According to Peker's study, Z-plasty and Y-V advancement were previously used in conjunction to promote the release of linear flexion contractures in the fingers, including the thumbs.[10]

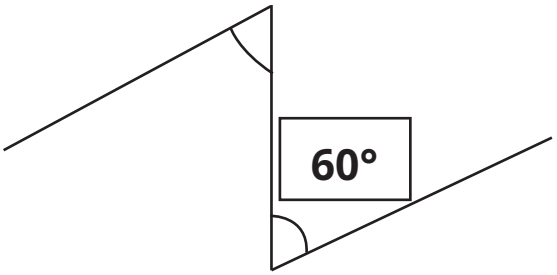
However, methods to predict the surgical outcomes of 60 degree Z-plasty, and data relating to outcome of Z-plasty over the flexion contacture that yield the best surgical outcomes are scarce. Accordingly, the aim of this study is to predict z-plasty lengthening at 60 degrees of flexion contracture of fingers in patients at the Burn and Plastic Surgery Centre, a unit of Hayatabad Medical Complex Hospital, Peshawar. Because Z

-plasty incision doesn't require any skin excision or any tissue lose, so advantageous for treating the flexion contracture of fingers.

Methodology

With approval from the institution's research committee and ethical board, this series study was carried out at the Burn and Plastic Surgery Centre, Hayatabad, in Peshawar, Pakistan, from October 2023 to March 2025. Through non-probability sequential sampling, information on 289 patients from diverse age groups and both gender was acquired. All patients meeting the inclusion criteria i-e digital contracture after burns were included in the study through OPD and admitted in the ward for further work up. The purpose and benefits of the study was explained to all patients and they were assured that the study is done purely for research and data publication and a written informed consent was obtained.

All patients got a thorough clinical examination, complete history review, and baseline pre-operative tests. Variables were measured using gonimetry both before and after the surgery, and the procedure was planned. All patient underwent Z-plasty incision under anesthesia.The Z-plasty technique involves the creation of two flaps from three equal limbs and two same-degree angles as shown



Pre-designed Performa were used for data collection and analysis. It contained variables such as pre-op extension latency, post-op extension lag, and the difference between the two and categorize into mid and moderate, and effectiveness are accordingly measured. Patient who had dupuytrens contracture, tophacous gout, skin disease or any pathological joint disease were omitted.

SPSS version 26.0 was used to analyse the data. Mean ± Standard deviation were calculated for quantative variables like pre op extension lag at PIP joint and age. Frequency and percentages were calculated for categorical variables like gender , post op angle at PIP joint and effectiveness of 60 degree Z-plasty. Outcome variables were stratified among gender post op angle at PIP joint and age.

Post-stratification Chi square test was applied keeping P value < 0.05 will be considered significant.

Results

The study included a total of 289 patients, with a mean age of 37.96±12.32 years, ranging from 18 to 60 years. The participants were categorized into age groups, with 46.0% of participants falling within the 18 to 35 age range, 33.6% between 36 and 50 years, and 20.4% between 51 and 60 years. The gender distribution showed that there were 52.2% male and 47.8% female participants. The pre-operative extension lag at the PIP joint (proximal interphalangeal joint) was recorded for each patient, with values ranging from 30 degrees to 60 degrees. The mean pre-operative angle was 44.80±8.92 degrees.

Regarding the post-operative angle at the PIP joint, the

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data showed that a significant portion of the patients (72.3%) had mild contractures with an angle of < 10 degrees, indicating a successful reduction in flexion contracture following the surgery. The remaining 27.7% of patients presented with a moderate contracture (angle > 10 degrees).

In terms of the effectiveness of the 60-degree Z-plasty procedure, 72.3% of patients achieved a favorable outcome, while 27.7% had less favorable results. The study aimed to assess if certain factors, such as age, gender, and post-operative angles, correlated with the success of the Z-plasty procedure.

Statistical analysis of the results revealed that age distribution did not significantly affect the surgical outcome (p = 0.51). The age group 18–35 years showed 47.4% effectiveness, and the group 36–50 years exhibited 31.6% effectiveness, while the 51–60 years group had 21.1% effectiveness. These findings suggest that age may not be a major determinant in the success of Z-plasty.

Gender differences also appeared to have little impact on the outcome, as 52.2% of males and 47.8% of females experienced positive outcomes, with a p-value of 0.95, indicating no significant gender-based differences in effectiveness.

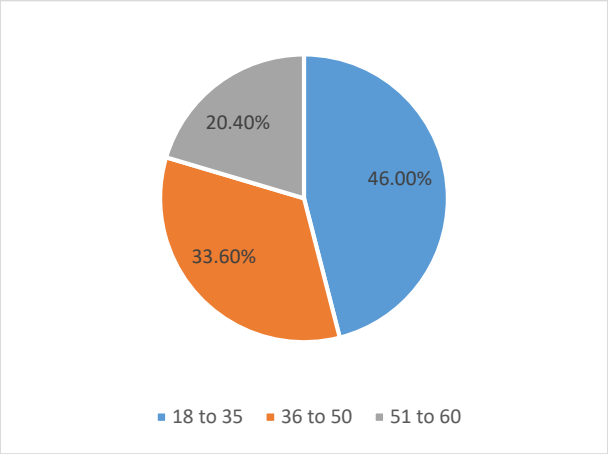

Figure 1: Age distribution (Years)

Regarding the post-operative angle at the PIP joint, all patients who had mild contractures (<10 degrees) showed successful outcomes, and no patients with moderate contractures (>10 degrees) achieved the desired improvement. This suggests that Z-plasty is highly effective in cases where the angle correction is minor but less effective for more severe contractures.

Table 1. Gender distribution

Gender	Frequency	Percent
Male	151	52.2
Female	138	47.8
Total	289	100.0

Table 2. Postop angle at PIP joint

Postop angle at PIP joint	Frequency	Percent
Mild (< 10 degrees)	209	72.3
Moderate (> 10 degrees)	80	27.7
Total	289	100.0

Table 3. Effectiveness of 60 degree Z-plasty

Effectiveness of 60 degree z-plasty	Frequency	Percent
Yes	209	72.3
No	80	27.7
Total	289	100.0

Table 4. Stratification of effectiveness of 60 degree Z-plasty with various parameters

Parameters		Effectiveness of 60 degree Z-plasty				P value
		Yes		No		
		Frequency	Percentage	Frequency	Percentage	
Age distribution (Years)	18 to 35	99	47.4%	34	42.5%	0.51
	36 to 50	66	31.6%	31	38.8%	
	51 to 60	44	21.1%	15	18.8%	
Gender	Male	109	52.2%	42	52.5%	0.95
	Female	100	47.8%	38	47.5%	
Postop angle at PIP joint	Mild (< 10 degrees)	209	100.0%	0	0.0%	0.0001
	Moderate (> 10 degrees)	0	0.0%	80	100.0%	

Discussion

Our results showed that around 72.3% of patients achieved favorable outcomes with mild post-operative contractures (<10 degrees), while 27.7% had moderate contractures (>10 degrees), indicating a clear link between the severity of the contracture and surgical success. This finding aligns with the principles outlined by Aasi SZ, who highlighted that Z-plasty is particularly effective for scar lengthening and realignment, especially where the scar can be redirected along natural skin tension lines.[12] However, our study also highlighted the limitations of Z-plasty in cases of moderate contractures..

Age and gender did not significantly influence the outcomes in our study. This is in contrast to Bai et al.'s findings, which showed a higher percentage of children under the age of twelve. This suggests that younger patients are more likely to experience these incidental deformities and may need more specialized procedures like flaps because of their increased vulnerability to recurrence and growth-related changes.[13] However we did not stratify outcomes by pediatric versus adult patients which may explain this discrepancy. Our study did not find a notable association between the outcomes and gender as well.

The post-operative angle at the PIP joint emerged as a critical factor of success in our study. All patients with mild contractures (<10 degrees) achieved successful outcomes while none with moderate contractures (>10 degrees) did. This finding is affirmed by Cho et al, who classified scar contractures into dimensional types, and they recommended Z-plasty for superficial linear contractures (Type 1) but cautioned against its use for deeper or planar contractures (Type 3), where flaps or grafts might be more appropriate.[14] Our results thus underscore the importance of preoperative assessment to identify those patients who are most likely to benefit from Z-plasty. The study by Salam and Amin et al further validates this, they noted that Z-plasty is ideal for linear scars but less effective for wider or more complex scars where alternative techniques like multiple Z-plasties or flap reconstructions may be warranted.[14]

The 60-degree angle which we used in our study was chosen for its balance between lengthening and technical feasibility, a decision corroborated by Aasi SZ validated this choice by showing that 60 degree angles result in a 90 degree redirection of centre limb and an increase of 75% in scar length.[12] Huang et al. proposed that modified Z-plasty designs with angles up to 90 degrees for severe webbed contractures which achieves greater lengthening and mobilization of surrounding tissue.[15] This suggests that while the 60-degree Z-plasty is effective for mild to moderate cases more aggressive modifications may be necessary for severe contractures especially those involving multiple joints. Our study did not explore such modifications, which could be a valuable direction for future research.

Regarding the postoperative care, Bai et al emphasized the importance of splinting and physiotherapy to maintain joint mobility and prevent recurrence.[13] This suggests that long-term success depends on adjunct therapies particularly in high-risk patients such as children or patients with severe initial contractures.

In light of these comparisons, our study contributes to the literature, supporting the 60-degree Z-plasty as a reliable option for mild flexion contractures of the fingers. However, the limitations observed in moderate cases indicate the need for a more modified approach for complex deformities. Future studies could explore hybrid approaches such as combining Z-plasty with adjunctive therapies.

Conclusion

In conclusion, 60-degree Z-plasty shows that it was highly effective for mild flexion contractures of the fingers with 72.3% achieving favorable outcomes while its limitations in moderate cases suggest the need for alternative techniques in severe deformities.

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Authors' Contribution Statement

JB contributed to the conception, design, acquisition, analysis, interpretation of data, drafting of the manuscript, and critical review of the manuscript. MK contributed to the conception, design, acquisition, interpretation of data, drafting of the manuscript, and final approval of the version to be published. NH contributed to the acquisition, analysis, interpretation of data, drafting of the manuscript, and critical review of the manuscript. IBZ contributed to the acquisition, analysis, and interpretation of data. SR contributed to the acquisition, analysis, and interpretation of data. SAS contributed to the acquisition, analysis, and interpretation of data. RF contributed to the acquisition, analysis, and interpretation of data. SSS contributed to the acquisition, analysis, and interpretation of data. All authors are accountable for their work and ensure the accuracy and integrity of the study.

Conflict of Interest

Authors declared no conflict on interest

Grant Suppport and Financial Disclosure

None

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.