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## Comparative Study of Clinical and Radiological Outcomes of Unstable Proximal Femoral Fractures Managed by Cephalomedullary Nailing VS Dynamic Condylar Screw

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### ABSTRACT

This study compares the clinical and radiological outcomes of unstable proximal femoral fractures managed by cephalomedullary nailing (CMN) versus dynamic condylar screw (DCS) fixation. A prospective randomized study was conducted between April 2023 and August 2024 at the Department of Orthopaedics, ESI-PGIMSR, New Delhi, involving 48 patients divided into two equal groups. Group A (n=24) received CMN, while Group B (n=24) was treated with DCS. Clinical outcomes were assessed using the Harris Hip Score (HHS) at preoperative, 6-week, 3-month and 6-month intervals and radiological union was evaluated using plain X-rays at the same time points. The results demonstrated that Group A (CMN) had significantly better functional outcomes compared to Group B (DCS), with higher mean HHS scores at 3 and 6 months ( $p < 0.001$  and  $p = 0.009$ , respectively). Radiological union was also faster in Group A, with 91.7% achieving complete union by 6 months compared to 54.2% in Group B ( $p < 0.001$ ). Furthermore, Group A patients experienced fewer complications and quicker return to daily activities, with 91.7% back to normal activities by 6 months, compared to none in Group B ( $p < 0.0001$ ). This study concludes that cephalomedullary nailing offers superior clinical and radiological outcomes for unstable proximal femoral fractures compared to dynamic condylar screw fixation, making it a more effective option for managing such fractures.

## INTRODUCTION

Trochanteric fractures are the fractures occurring in the region of proximal femur extending from extracapsular basilar neck to the lesser trochanter and proximal to the medullary canal<sup>[1]</sup>. It is one of the most common fractures occurring in elderly patients<sup>[2]</sup>. The incidence of trochanteric fractures has increased due to more life expectancy along with osteoporosis. Studies done by Cooper<sup>[3]</sup> and Gullberg<sup>[4]</sup> in the 1990s predicted that approximately 4.50-6.26 million hip fractures will occur all over the world by 2050 and 50% of them will occur in the Asian subcontinent. Unstable fracture patterns are those fractures with fracture line extending to the sub-trochanteric area, lateral wall blowout, comminuted posteromedial wall, reverse oblique (femoral shaft displaced medially) and a variant of reverse oblique fractures<sup>[2,6]</sup>. Trochanteric fractures (irrespective of the fracture geometry) are often operated on unless some contraindication is present for operative treatment (severe comorbidities endangering the life of the patient in the intraoperative or perioperative period). However, unstable trochanteric fracture patterns pose a great challenge in management with high post-operative complications including mortality. They have also become a health resource issue due to the high cost of care required following injury<sup>[5]</sup>. Extramedullary (e.g., DHS, Dynamic hip screw., CHS, Compression hip screw., DCS, Dynamic condylar screw., PFLCP, Proximal femoral locking compression plate) and intramedullary (e.g., IMHS, Intramedullary hip screw., PFN, Proximal femoral nail., PFNA, Proximal femoral nail anti-rotation) fixation are the contemporary treatment options and both of them have received empirical support<sup>[7]</sup>. Although the extramedullary sliding screw (e.g., DHS, Dynamic hip screw) was once regarded as the gold standard in the treatment of trochanteric hip fractures, intramedullary devices are now outnumbering extramedullary devices<sup>[8,9]</sup>. Several studies have found that intramedullary devices are more effective than extramedullary devices for the fixation of unstable trochanteric femoral fractures and that extramedullary fixation should be used with caution due to greater complication rates and poor functional outcomes. Other studies, on the other hand, found no significant difference in outcomes when intramedullary and extramedullary fixations were used<sup>[10-13]</sup>. Furthermore, most previous studies for unstable intertrochanteric fractures were retrospective or non-specific concerning fracture patterns, demanding more research<sup>[14-16]</sup>.

### Objectives:

- To compare clinical outcomes between cephalomedullary nailing and dynamic condylar screw using Harris Hip Score.

- To assess radiological union at 6 weeks, 3 months and 6 months postoperatively using plain X-rays.

## MATERIALS AND METHODS

**Study Design:** Prospective randomized Study.

**Study Duration:** April 2023- August 2024.

**Study Area:** The study will be carried out in the Department of Orthopaedics, Employees State Insurance -Post Graduate Institute of Medical Sciences and Research (ESI-PGIMSR), Basaidarapur, New Delhi after the clearance from the Ethics Committee.

**Study Population:** Patients undergoing cephalomedullary nailing and dynamic condylar screw for unstable proximal femoral fractures.

**Study Sample Size:** 24 in each group.

### Inclusion Criteria:

- Patients with Unstable proximal femoral fractures.
- Age -18-70 years.

### Exclusion Criteria:

- Open fractures.
- Skeletally immature patients.
- Pathological fractures.
- Any Active infection.
- Old non-unions and mal-unions.
- Previous surgery on proximal femur.
- Femoral neck fractures.
- Femoral head fractures.
- sample size of 48 patients.

### Statistical Analysis:

- The data were initially checked for completeness and data was cleaned for errors and missing values. The corrected data was then entered into Microsoft Excel after preparing a Master-chart. Data analysis was done using licensed SPSS software version 21.0 (Chicago, Illinois). Univariate analyses were done initially and the results were presented with the help of tables, text, bar-diagrams and pie-charts. Descriptive statistics were used to calculate frequencies of categorical variables and measures of central tendencies and dispersion were used to describe continuous variables. Bi-variate analyses was done using the Chi square test/Fisher's Exact test, to determine the association between categorical variables and for quantitative variable t- test or Mann-Whitney test was used.
- P value <0.05 was considered as statistically significant.

**Ethical Issues:**

- Approval from Institutional Ethical Committee of the hospital was taken before the start of the study. Written and informed consent taken from the participants before proceeding the study. Each eligible subject was explained about the purpose of the study by the investigator and an informed consent was obtained, prior to inclusion. They were assured of complete confidentiality of information and the option of withdrawing from the study at any point of time. The study did not involve any method that puts the subjects, family members or the investigator at risk.

**RESULTS AND DISCUSSIONS**

- **Group A:** Patients treated with ORIF/CRIF+PFN.
- **Group B:** Patients treated with ORIF/CRIF +DCS.

**Table 1: Age Distribution of Study Participants**

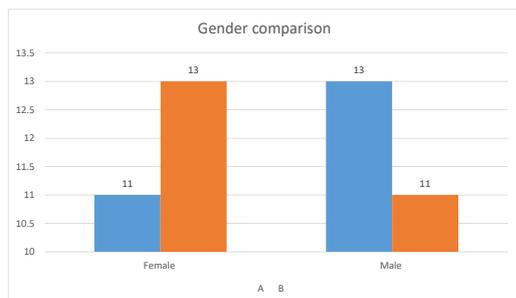
Group	Mean	SD	Median	Minimum	Maximum	p-value
A	51.875	18.5644	63.500	17.0	69.0	0.196
B	57.417	9.1076	60.000	35.0	69.0	
Total	54.646	14.7338	60.000	17.0	69.0	

The age distribution of study participants across the two treatment groups shows that Group A (ORIF/CRIF + PFN) had a mean age of 51.88 years with a standard deviation (SD) of 18.56 years and the age range was 17.0-69.0 years. Group B (ORIF/CRIF + DCS) had a mean age of 57.42 years with SD of 9.11 years and an age range of 35.0-69.0 years. The p-value of 0.196 indicates that the difference in age distribution between the two groups was not statistically significant.

**Table 2: Distribution of Study Participants According to Age Among Both Group**

Age group	A		B		p-value
	Count	%	Count	%	
≤60 years	11	45.8%	14	58.3%	0.386
>60 years	13	54.2%	10	41.7%	
Total	24	100.0%	24	100.0%	

Out of the 24 participants in Group A (treated with ORIF + PFN), 11 (45.8%) were aged 60 years or younger and 13 (54.2%) were older than 60 years. In Group B (treated with ORIF + DCS), 14 out of 24 participants (58.3%) were 60 years or younger, while 10 participants (41.7%) were older than 60 years. The difference in age distribution between the two groups was not statistically significant, as indicated by a p-value of 0.386.



**Fig. 1: Distribution of Study Participants According to Gender Among Both Group**

Out of the 24 participants in Group A (treated with ORIF/CRIF+PFN), 11 (45.8%) were female and 13 (54.2%) were male. In Group B (treated with ORIF/CRIF + DCS), 13 out of 24 participants (54.2%) were female, and 11 participants (45.8%) were male. The gender distribution between the two groups did not show a statistically significant difference, with a p-value of 0.564. Out of the 24 participants in Group A, 1 (4.2%) was injured due to a physical assault, 6 (25.0%) from a fall from stairs, 7 (29.2%) from a road traffic accident (RTA) and 10 (41.7%) from a slip and fall. Similarly, in Group B, no participants (0.0%) were injured due to a physical assault, 6 (25.0%) from a fall from stairs, 7 (29.2%) from an RTA and 11 (45.8%) from a slip and fall. The distribution of the mode of injury across the two groups did not show a statistically significant difference, with a p-value of 0.790. Group A, 10 (41.7%) had left-side injuries, while 14 (58.3%) had right-side injuries. In Group B, 11 (45.8%) participants had left-side injuries and 13 (54.2%) had right-side injuries. The difference in the distribution of the side of injury between the two groups was not statistically significant, with a p-value of 0.771.

**Table 3: Distribution of Study Participants According to AO Classification Among Both Group**

AO classification	A		B		p-value
	Count	%	Count	%	
31A1	3	12.5%	2	8.3%	0.794
31A2	8	33.3%	10	41.7%	
31A3	13	54.2%	12	50.0%	
Total	24	100.0%	24	100.0%	

The mean duration from injury to operation was 16.04 days (SD 6.92) in Group A, ranging from 6 to 32 days and 17.04 days (SD 4.19) in Group B, ranging from 7-25 days. The median duration was 15.00 days in Group A and 16.00 days in Group B. The difference in the duration between the two groups was not statistically significant, with a p-value of 0.548.

**Table 4: Distribution of Duration of Operation (min) Among Both Group Study Participants**

Group	Mean	SD	Median	Minimum	Maximum	p-value
A	70.458	6.1572	70.000	60.0	88.0	0.0001
B	90.208	6.9843	90.000	75.0	101.0	
Total	80.333	11.9170	80.000	60.0	101.0	

The mean duration of operation was significantly shorter in Group A compared to Group B. In Group A, the mean operation time was 70.46 minutes (SD 6.16), ranging from 60-88 minutes and a median of 70.00 minutes. In Group B, the mean operation time was 90.21 minutes (SD 6.98), ranging from 75-101 minutes and a median of 90.00 minutes. The difference in operation duration between the two groups was statistically significant, with a p-value of 0.0001.

**Table 5: Comparison of Functional Outcome Measured by HHS Between Both Groups at Different Time Intervals**

HHS	A		B		p-value
	Mean	SD	Mean	SD	
Pre-op	11.625	2.1832	10.833	1.9035	0.187
6 week	40.000	7.4367	36.542	5.0903	0.066
3 months	66.792	5.5245	56.375	5.4118	0.0001
6 months	87.375	7.6886	81.125	8.0774	0.009

Pre-operative HHS scores, Group A had a mean score of 11.625 (SD=2.1832), while Group B had a mean score of 10.833 (SD=1.9035), with no statistically significant difference (p=0.187). At 6 weeks, Group A's mean score was 40.000 (SD=7.4367) compared to Group B's 36.542 (SD=5.0903), approaching significance with a p-value of 0.066. By 3 months, Group A had a significantly higher mean score of 66.792 (SD=5.5245) than Group B, which had a mean score of 56.375 (SD=5.4118), with a highly significant p-value of 0.0001. At 6 months, Group A's mean score was 87.375 (SD=7.6886), significantly higher than Group B's mean score of 81.125 (SD=8.0774), with a p-value of 0.009. In terms of functional outcomes measured by HHS, Group A had 14 individuals (58.3%) classified as having an excellent outcome, while Group B had 7 individuals (29.2%) with the same classification, showing a significant difference (p=0.0001). Both groups had 6 individuals (25.0%) each categorized as having a fair outcome. Group A had 4 individuals (16.7%) with a good outcome, compared to 8 individuals (33.3%) in Group B. Additionally, none of the individuals in Group A had a poor outcome, while 3 individuals (12.5%) in Group B did. The overall p-value indicates a significant difference in the distribution of outcomes between the groups. At 3 months, Group A achieved complete union in 16 individuals (66.7%), compared to just 3 individuals (12.5%) in Group B, with a highly significant p-value of 0.0001. By 6 months, Group A had 22 individuals (91.7%) with complete union, while Group B had 13 individuals (54.2%), also showing a highly significant difference with a p-value of 0.0001.

Table 6: Comparison of Clinical Outcomes Between Both Groups at Different Time Intervals

Union	A		B		p-value
	Count	%	Count	%	
<b>6 weeks</b>					
Full weight bearing	17	70.8%	0	0.0%	0.0001
Not walking	0	0.0%	11	45.8%	
Partial weight bearing	4	16.7%	0	0.0%	
Partial weight bearing, mild pain	3	12.5%	0	0.0%	
Walking with non-weight-bearing	0	0.0%	13	54.2%	
<b>At 3 months</b>					
Full weight bearing	21	87.5%	0	0.0%	0.0001
Partial weight bearing	3	12.5%	24	100.0%	
<b>6 months</b>					
Back to daily activities	22	91.7%	0	0.0%	0.0001
Full weight bearing	1	4.2%	14	58.3%	
Partial weight bearing	1	4.2%	10	41.7%	

At 6 weeks, Group A had 17 individuals (70.8%) able to fully bear weight, significantly more than Group B, which had none (0.0%). Group A also had 4 individuals (16.7%) in partial weight bearing, 3 individuals (12.5%) in partial weight bearing with mild pain and none (0.0%) walking with non-weight-bearing. Conversely, Group B had 11 individuals (45.8%) not walking and 13 individuals (54.2%) walking with non-weight bearing. At 3 months, Group A had 21 individuals (87.5%) fully weight bearing, compared to none (0.0%) in Group B. Group B had all 24 individuals (100.0%) in partial

weight bearing. In contrast, Group A had only 3 individuals (12.5%) in this category. By 6 months, 22 individuals (91.7%) in Group A were back to daily activities, significantly more than none (0.0%) in Group B. Group A had 1 individual (4.2%) fully weight-bearing and 1 individual (4.2%) in partial weight bearing, while Group B had 14 individuals (58.3%) fully weight bearing and 10 individuals (41.7%) in partial weight bearing. The p-values indicate that the differences in clinical outcomes between the two groups were statistically significant (p<0.0001) at all the evaluated time points.

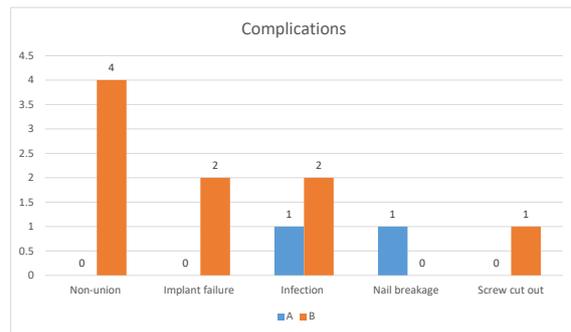


Fig. 2. Comparison of Complications Between Both Groups

Group A experienced no cases of non-union, implant failure, or screw cut out. In contrast, Group B had 4 cases (16.7%) of non-union, with a significant p-value of 0.012. Group B also had 2 cases (8.3%) of implant failure, though this difference was not statistically significant (p=0.201). Infection rates were slightly higher in Group B, with 2 cases (8.3%) compared to 1 case (4.2%) in Group A, but this was not significant (p=0.469). Nail breakage occurred in 1 individual (4.2%) in Group A, while Group B had none (0%), with no significant difference (p=0.782). Screw cut-out was observed in 1 individual (4.2%) in Group B, with no cases in Group A, also showing no significant difference (p=0.782).

Unstable proximal femoral fractures are a significant clinical challenge due to their complex management and impact on patient mobility and quality of life. Traditionally, these fractures have been treated with various surgical techniques, including cephalomedullary nailing (PFN) and dynamic condylar screw (DCS). Cephalomedullary nailing involves inserting a nail through the femoral head and neck to stabilize the fracture, while dynamic condylar screw fixation involves placing screws to achieve stabilization. Both methods aim to restore limb function and achieve fracture union but differ in their biomechanical principles and surgical approaches. PFN is known for its ability to provide stable fixation in complex fractures and potentially shorter recovery times, while DCS is a more conventional approach with a longer track record. The current study aimed to compare the clinical and radiological outcomes of unstable proximal

femoral fractures treated with cephalomedullary nailing (ORIF/CRIF+PFN) and dynamic condylar screw (ORIF/CRIF+DCS). The study included 48 participants, equally divided into two groups based on the treatment method.

**Age and Gender Distribution:** The age distribution of the participants in both groups was not statistically significant, with Group A (ORIF/CRIF+PFN) having a mean age of 51.88 years and Group B (ORIF/CRIF+DCS) having a mean age of 57.42 years. This finding is consistent with the study conducted by Kachewar<sup>[17]</sup> where the majority of patients (40%) were aged between 51 and 60 years, with a mean age of 58.2±3.26 years. Similarly, Nayak<sup>[18]</sup> also reported that the majority of patients (37.14%) were aged between 51 and 60 years. Regarding gender distribution, the current study did not show a statistically significant difference between the two groups. This finding is in contrast with the study by Kachewar<sup>[17]</sup> which had a higher proportion of male patients (66.66%). Nayak<sup>[18]</sup> also reported a higher percentage of male patients (65.71%) in their study.

**Mode and Side of Injury:** The distribution of the mode of injury and side of injury across the two groups did not show a statistically significant difference in the current study. This finding is not directly comparable to the mentioned studies, as they did not specifically report on the mode and side of injury. Sarkar<sup>[19]</sup> did a similar study and found that among a total of 80 cases, 32 (40%) cases were due to accidental fall and 48 (60%) cases were due to road traffic accident. Regarding the involvement of the right or left femur in the injury, it observed that 44 (55%) cases were left sided and 36 (45%) were right-sided.

**AO Classification:** The distribution of AO classification between the two groups did not show a statistically significant difference in the current study. Jamil<sup>[20]</sup> reported that the AO 31A2 fracture pattern was more common in the DCS group (63.64%), whereas the AO 31A3 pattern was more frequent in the PFN group (60.00%). However, the current study did not find a significant difference in the distribution of AO classification between the two groups.

**Duration of Operation:** The current study found that the mean duration of operation was significantly shorter in Group A (ORIF/CRIF+PFN) compared to Group B (ORIF/CRIF + DCS). This finding is consistent with the study by Jamil MF *et al.* (2022), which reported a significantly shorter mean operative time for the PFN group (79.67±12.02 minutes) compared to the DCS group (96.36±15.51 minutes). Sadowski<sup>[21]</sup> also noted that intramedullary nailing might be the choice of implant due to less operating time. Sarkar *et al*

found the average operating time for PFN group was 80 min, which was significantly lower than 104 min of the DCS group.

**Functional Outcome (Harris Hip Score):** The current study found that Group A (ORIF/CRIF+PFN) had significantly better functional outcomes, as measured by the Harris Hip Score (HHS), compared to Group B (ORIF/CRIF+DCS) at 3-and 6-months post-surgery. Kachewar<sup>[17]</sup> also reported that patients treated with PFN demonstrated better functional outcomes compared to those treated with DCS, with a higher mean HHS for the PFN group (90) compared to the DCS group (85). Nayak S *et al.* (2022) found a significant association between the mode of treatment and functional outcome, with patients treated using PFN showing better outcomes. Prakash<sup>[22]</sup> revealed that in Group DHS, results were excellent in 34.78% (eight patients out of 23 patients), good in 43.48% (10 patients out of 23 patients), fair in 17.39% (four patients out of 23 patients) and poor in 4.35% (one patient out of 23 patients). In Group PFN, results were excellent in 56.52% (13 patients out of 23 patients), good in 34.78% (eight patients out of 23 patients) and fair in 8.70% (two patients out of 23 patients). There was not much significant difference in results distribution between the two groups.

**Radiological Outcome (Complete Union):** The current study found that Group A (ORIF/CRIF+PFN) achieved a significantly higher rate of complete union at both 3-and 6-months post-surgery compared to Group B (ORIF/CRIF+DCS). Jamil<sup>[20]</sup> reported that union was achieved in 92.31% of patients treated with PFN compared to 28.57% in the DCS group, which is consistent with the findings of the current study. Kachewar<sup>[17]</sup> also noted that the average union time was shorter for the PFN group (16 weeks) compared to the DCS group (19 weeks).

**Clinical Outcome (Weight Bearing and Return to Daily Activities):** The current study found that Group A (ORIF/CRIF+PFN) had significantly better clinical outcomes in terms of weight bearing and return to daily activities at 6 weeks, 3 months and 6 months post-surgery compared to Group B (ORIF/CRIF + DCS). Kachewar<sup>[17]</sup> reported that patients treated with PFN demonstrated better functional outcomes, with the ability to bear full weight within five weeks post-surgery. Nayak<sup>[18]</sup> also found that patients treated using the PFN approach started full weight bearing after 6 weeks, with no pain observed, while patients treated using the DCS approach experienced mild pain and were not able to bear full weight.

**Complications:** The current study found that Group B (ORIF/CRIF + DCS) had a significantly higher rate of

non-union compared to Group A (ORIF/CRIF+PFN). The rates of implant failure, infection, nail breakage and screw cut-out were not significantly different between the two groups. Prakash<sup>[22]</sup> revealed that there were two cases with superficial surgical site infection in the DHS group which were treated with culture sensitivity-based antibiotic usage and infection subsided. Limb length discrepancy of 1-2 cm was noted in three patients (two patients in the DHS group and one patient in the PFN group) which were treated with shoe raise and gait training. Stephen<sup>[23]</sup> concluded that implant selection should be based on fracture pattern, with blade plates serving as an important implant for subtrochanteric fractures due to their ability to provide anatomic reduction and good maintenance of reduction. They also noted that good results were obtained from cephalomedullary implants, although outcomes were not well documented at that time. Sadowski<sup>[24]</sup> found that intramedullary nailing might be the preferred implant due to less blood loss and shorter operating time. However, their study had limitations, such as the need for open reduction in some cases treated with dynamic condylar screws, which may have adversely affected the time to fracture union. Daniel D Bohl<sup>[24]</sup> concluded that there were little to no differences between intramedullary and extramedullary implants for intertrochanteric hip fractures. Johnny Paulsson<sup>[25]</sup> reported that technical complications in unstable pertrochanteric and subtrochanteric fractures were less frequent and less severe with a treatment protocol based on Medoff sliding plate (MSP) fixation compared to intramedullary nail (IMN) fixation. They suggested that a vast majority of unstable pertrochanteric fractures are best treated with MSP in biaxial mode and stand a greater risk of major complications if treated with dynamic hip screw (DHS) or IMN. G. Praneeth Kumar Reddy<sup>[26]</sup> concluded that dynamic condylar screw (DCS) is a safe and effective surgical procedure, provided less muscle and tissue stripping and stable internal fixation are followed. Vamsee Krishna<sup>[27]</sup> found that proximal femur locking compression plate (PF-LCP) is superior due to its ability to revive and maintain anatomy and biomechanical stability. However, they cautioned that if anatomical reduction is not achieved and patient compliance is low, the use of PF-LCP should be carefully weighed against other implants. Ryo Yoshikawa<sup>[28]</sup> reported on a new device, Tres Lock, designed based on Japanese anatomical characteristics, which showed good anatomical stability in the Japanese population. However, they noted that careful follow-up is needed to assess its long-term effectiveness.

## CONCLUSION

The current study demonstrates that cephalomedullary nailing (ORIF+PFN) is associated with better clinical and radiological outcomes compared to dynamic condylar

screw (ORIF+DCS) in the treatment of unstable proximal femoral fractures. Patients treated with ORIF+PFN had shorter operation times, better functional outcomes, higher rates of complete union and better clinical outcomes in terms of weight bearing and return to daily activities. These findings are generally consistent with the results of other studies comparing intra medullary and extra medullary implants for the treatment of unstable proximal femoral fractures. However, it is important to note that the choice of implant should be based on various factors, including fracture pattern, patient characteristics and surgeon experience. While the current study and several others suggest that intra medullary nailing may be superior to extra medullary fixation in many cases, there are situations where other implants, such as blade plates, sliding hip screws, or locking compression plates, may be more appropriate. The evidence base for the treatment of unstable proximal femoral fractures is continually evolving and ongoing research is needed to refine treatment algorithms and evaluate the effectiveness of new implants and techniques.

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