ORIGINAL ARTICLE

Comparative Study between Percutaneous Screw Versus 8 Plate in Management of Genu Valgum in Children

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Abstract

Background: ***Genu valgum is a common orthopaedic problem in children. Defined as lateral mechanical axis deviation and may be physiological and pathological.***

Aim: ***This study aimed to compare between percutaneous screw and 8 plate in management of genu valgum in kids.***

Patients and methods: ***This prospective investigation included 20 cases with genu valgum coming to outpatient clinic of AL-Azhar university hospital (Al Hussien and Sayed Galal Hospital) Between a duration of February 2024 to February 2025.***

Results: ***The 8-plate group demonstrated a significantly higher mean correction rate p = 0.004 and a longer implant duration p = 0.047 compared to the percutaneous screw group. While the initial IMD was slightly higher in the 8-plate group p = 0.094, the final IMD reduction was significantly greater in the 8-plate group p < 0.001, indicating superior correction. However, 20% of cases in the 8-plate group experienced correction failure, whereas no failures occurred in the screw group. Implant migration was absent in both groups, and a single infection (10%) occurred in the screw group, with no significant distinction compared to the 8-plate group (p > 0.05).***

Conclusion: ***Both the Percutaneous Screw and 8-Plate techniques show similar results in terms of demographic and clinical characteristics, but the 8-Plate technique has a higher correction rate and smaller final intermalleolar distance, indicating superior deformity correction. Both techniques have a low incidence of complications, with the 8-Plate group having a slightly higher risk of failure, overcorrection, and infection.***

Keywords: Percutaneous Screw; 8-Plate, Genu Valgum; Children

1. Introduction

Genu valgum is a common orthopaedic problem in kids. Defined as lateral mechanical axis deviation, it may be physiological and pathological. [1]

The Physiological genu valgum begins at the age of 2 years old, characterized by a tibiofemoral angle lower than fifteen degrees, bilateral, and spontaneously resolves at the age of 6 years old. Management for mild cases through Observation, correct general condition, vitamin D, Bracing, and Physiotherapy. [2]

Pathological genu valgum can be either bilateral or unilateral. Unilateral can be idiopathic or attributable to physical injuries such as proximal metaphyseal tibial fractures, distal femoral physeal fractures, infections, vascular insults, and benign tumors such as fibrous dysplasia. While bilateral can be idiopathic or attributed to skeletal dysplasia and renal rickets, with a tibiofemoral angle of more than fifteen degrees in children < 10 years of age.[3]

"Windswept deformity" refers to the manifestation of an abnormal valgus deformity in a single knee associated with a varus deformity in the other knee. [4]

Diagnosis depends on history, clinical, laboratory, and radiological findings. [5]

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The objective of surgical management of pathologic genu valgum is restoration of normal mechanical-axis alignment and joint orientation.[6,7]

This study aimed to compare the percutaneous screw and 8 plate in the management of genu valgum in kids.

2. Patients and methods

This prospective investigation included 20 cases with genu valgum coming to the outpatient clinic of AL-Azhar University Hospital (Al Hussien and Sayed Galal Hospital) between February 2024 and February 2025.

Inclusion criteria: Skeletally immature cases, deformity around the knee, abnormal physiologic deformity, children 6-13 years old, bilateral and unilateral deformity.

Exclusion criteria: Skeletal maturity, physiologic angular knee deformity, kids below 6 or above 13 years old, neuromuscular disorders, and infectious disorders (osteomyelitis disturbing growth plate).

Methods: All patients were subjected to the following:

Preoperative evaluation involved a thorough assessment of the patient based on age, severity, and the cause of deformity, including clinical, laboratory, and radiological examinations. It evaluates limb length, symmetry, alignment, and causes of deformity. Laboratory tests include CBC, ESR, CRP, vitamin D, calcium, phosphorus, alkaline phosphatase, PTH, urine analysis, and renal function tests. Radiologically, long-film X-rays and scanograms assess mechanical axis deviation, deformity cause, severity, site, CORA, and plan management. The implant choice depends on the treatment method.

Surgical technique

Guided growth arrest using a plate: Guided growth arrest utilizing an eight-plate has been carried out under general or spinal anesthesia, with the case in a supine position on a conventional operating table and the C-arm positioned opposite the surgeon. The patient was draped from the umbilicus downwards without a tourniquet. The physis was identified fluoroscopically, and a 2 cm incision was made at the center of the physis (distal femur or proximal tibia). The fascia lata has been divided longitudinally, and the periosteal surface has been exposed through blunt dissection, ensuring the perichondrial ring remains intact. A fine guide K-wire was inserted and centralized under lateral fluoroscopic guidance. The plate was provisionally secured with a hypodermic needle, and its position confirmed fluoroscopically. Threaded guide wires have been inserted through the plate's main holes, parallel to the physis, followed by broaching the cortex with a cannulated drill and securing self-tapping 4.5 millimeter screws. Guide wires were removed before final screw tightening, and the plate's position was rechecked with anteroposterior and lateral fluoroscopic views. A compression bandage is applied following closure of the wound. Post-operative management: Cases have been discharged on the next day, having safely mobilised partially weight-bearing on crutches. Post-operative plain X-rays of the knee and entire length have been done. The compression bandage decreased following three to four days, and knee mobility improved. Complete weight bearing was typically attained in the second week. Follow-up: Cases have been followed up radiologically and clinically for two months. After successful correction of deformity, a standing scanogram confirmed the clinical impression. The intended repair was to restore the mechanical axis to pass through the inner two zones of a six-zone division of the knee, allowing for plate removal or metaphyseal screw removal.

Guided growth arrest by percutaneous transphyseal screw: Cases underwent temporary hemiepiphysiodesis in the supine position under general or spinal anesthesia without a tourniquet. Two techniques for screw configuration, oblique and vertical, were described by Metaizeau, with oblique screws used predominantly and vertical screws used only in one case. For oblique screws, a 1.6 mm K-wire was used to guide placement, ensuring it crossed the medial femoral physeal plate centrally and was checked fluoroscopically before drilling into the lateral metaphyseal cortex. A fully threaded cannulated 6.5 mm stainless steel screw was inserted transphyseally with at least 3–4 threads crossing the physis to avoid compressive forces, with screw head protrusion left slightly to facilitate removal. Vertical screw placement followed a similar technique, with the K-wire positioned centrally in both AP and lateral views, and screws inserted transphyseally without violating the articular surface. Screw removal involved blunt dissection to locate the screw head, followed by extraction with a screwdriver, ensuring careful coupling before removal. Washers were avoided in all cases to prevent compressive forces over the physis.

Post-operative management: After the operation, whether insertion or removal of screws, cases have been allowed to fully weight bear as tolerated immediately following the operation. We advised the patients to perform their daily life activities normally except for vigorous exercise for 2 weeks only till sutures removal.

Statistical analysis

The recorded information has been analyzed utilizing the Statistical Package for the Social Sciences, version 23.0 (SPSS Inc., Chicago, Illinois,

USA). Quantitative data have been presented as mean ± standard deviation and ranges for parametric distributions, whereas non-parametric variables have been presented as median with inter-quartile range (IQR). The qualitative parameters have been presented as numbers and percentages. Normality of the information has been assessed utilizing the Kolmogorov-Smirnov and Shapiro-Wilk tests. The subsequent tests have been conducted: The independent-samples t-test and Chi-square test have been conducted with a confidence interval of ninety-five percent and an accepted margin of error of five percent. The p-value has been deemed significant as follows: a P-value less than 0.05 has been regarded as significant, a P-value less than 0.01 has been regarded as highly significant, and a P-value greater than 0.05 has been regarded as insignificant.

3. Results

There was statistically insignificant distinction among two groups as regard Gender, age and BMI p>0.05. (Table 1)

Table 1. Comparison of Demographic Characteristics among Percutaneous Screw and 8-Plate Techniques

		PERCUTANEOUS SCREW (N=10)		8 PLATE (N=10)		TEST VALUE	P-VALUE
		N	%	N	%		
GENDER	Male	6	60.0	5	50.0	X^2= 0.220	0.658
	Female	4	40.0	5	50.0		
AGE (YEAR)	Mean ±SD	9.4±1.6		10.7±1.5		t= 0.521	0.611
	Range	7 – 12		8 – 12			
BMI (KG/M^2)	Mean ±SD	21.8±2.21		22.1±2.4		t= 0.354	0.723
	Range	18 – 26		18 – 27			

utilizing: t-Independent Sample t test for Mean±SD; X2= Chi- Square test, p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant

The 8-plate group had slightly longer limbs compared to the percutaneous screw group, but this distinction wasn't statistically significant p>0.05. Deformity distribution was similar across the two groups, with no significant distinctions p>0.05. Both groups had a balanced distribution of tibial, femoral, and combined deformities. (Table 2)

Table 2. Comparison of Clinical Characteristics among Percutaneous Screw and 8-Plate Techniques

		PERCUTANEOUS SCREW (N=10)		8 PLATE (N=10)		TEST VALUE	P-VALUE
		N	%	N	%		
LIMB LENGTH (CM)	Mean ±SD	87.2±3.51		89.1±3.8		t= 0.525	0.608
	Range	82 – 92		84 – 93			
DEFORMITY	Unilateral	5	50.0	4	40.0	X^2= 0.211	0.646
	Bilateral	5	50.0	6	60.0		
ORIGIN OF DEFORMITY	Tibial	3	30.0	4	40.0	X^2= 0.417	0.519
	Femoral	4	40.0	4	40.0		
	Both	3	30.0	2	20.0		

The mean preoperative angular deviation and mechanical axis deviation were similar between the percutaneous screw group (15.5° and 25 mm) and the 8-plate group (16.0° and 27 mm), with no statistically significant distinctions (p = 0.685 and p = 0.397, correspondingly). (Table 3)

Table 3. Comparison of Preoperative Angles and Mechanical Axis Deviation among Percutaneous Screw and 8-Plate Techniques

		PERCUTANEOUS SCREW (N=10)	8 PLATE (N=10)	TEST VALUE	P-VALUE
PREOPERATIVE ANGLES DEVIATION (°)	Mean ±SD	15.5±3.0	16.0±3.2	0.413	0.685
	Range	12 – 21	11 – 22		
PREOPERATIVE MECHANICAL AXIS DEVIATION (MM)	Mean ±SD	25±5	27±6	0.869	0.397
	Range	18 – 32	19 – 34		

The 8-plate group had a significantly higher mean correction rate (1.68 cm/month vs. 1.06 cm/month, p = 0.004) and a longer implant duration (339.9 days vs. 283.2 days, p = 0.047) compared to the percutaneous screw group. (Table 4)

Table 4. Comparison of Correction Rate and Implant Duration among Percutaneous Screw and 8-Plate Techniques

		PERCUTANEOUS SCREW (N=10)	8 PLATE (N=10)	TEST VALUE	P-VALUE
CORRECTION RATE (CM/MONTH)	Mean ±SD	1.06±0.12	1.68±0.54	3.452	0.004**
	Range	0.75 – 1.25	0.81 – 2.25		
DURATION OF IMPLANT (DAYS)	Mean ±SD	283.22±128.37	339.9±64.2	2.315	0.047*
	Range	156 - 400	285 - 393		

The initial IMD was slightly higher in the 8-plate group (10.48 cm) compared to the percutaneous screw group (9.23 cm), but this distinction wasn't significant (p = 0.094). Nevertheless, the final IMD showed a significantly greater reduction in the 8-plate group (0.5 cm) compared to the percutaneous screw group (2.5 cm, p < 0.001), indicating superior correction with the 8-plate technique. (Table 5)

Table 5. Comparison of Intermalleolar Distance among Percutaneous Screw and 8-Plate Techniques

		PERCUTANEOUS SCREW (N=10)	8 PLATE (N=10)	TEST VALUE	P-VALUE
INITIAL INTERMALLEOLAR DISTANCE (CM)	Mean ±SD	9.23±1.19	10.48±0.89	1.894	0.094
	Range	8 - 11	9 – 11		
FINAL INTERMALLEOLAR DISTANCE (CM)	Mean ±SD	2.5±0.58	0.5±0.25	11.273	<0.001**
	Range	1 – 3.75	0 – 1		
P-VALUE		<0.001**	<0.001**		

There were no correction failures in the percutaneous screw group, while 20% of cases in the 8-plate group experienced failure. Implant migration was not observed. A single infection occurred in the percutaneous screw group (10%), with no significant distinction compared to the 8-plate group p> 0.05. (Table 6)

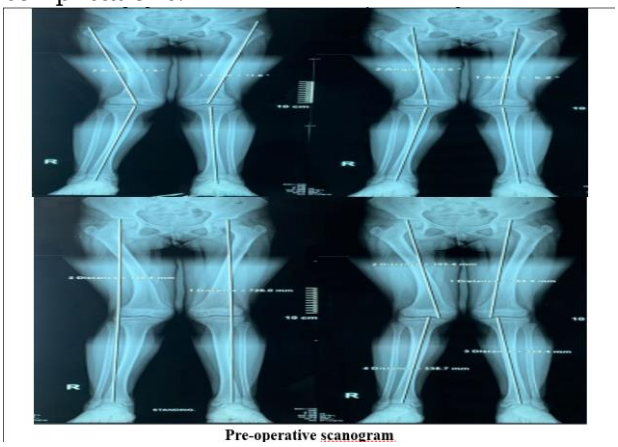
Table 6. Comparison of Complications among Percutaneous Screw and 8-Plate Techniques

	PERCUTANEOUS SCREW (N=10)		8 PLATE (N=10)		TEST VALUE	P-VALUE
	N	%	N	%		
FAILURE TO CORRECT	0	0	2	20	2.222	0.136
IMPLANT MIGRATION	0	0	0	0	-	-
INFECTION	1	10	0	0	1.053	0.305
OVERCORRECTION	0	0	1	10	1.053	0.305

Using: X2= Chi- Square test, p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant

CASE PRESENTATION

Case One: A girl 11 years old with bilateral genu valgum treated with temporary hemiepiphysiodesis by 8 plate and screws. an 11-year-old girl with bilateral genu valgum, underwent temporary hemiepiphysiodesis utilizing an 8-plate and screws. Preoperative measurements showed an intermalleolar distance (IMD) of 25 cm, mechanical axis deviation (MAD) of +20 mm on the right and +18 mm on the left, tibiofemoral angles (TFA) of 20° bilaterally, mechanical lateral distal femoral angles (mLDFA) of 80° on the right and 81.5° on the left, and medial proximal tibial angles (MPTA) of 86° on both sides. Postoperatively, the IMD was completely corrected to no distance, MAD improved to -2 mm bilaterally, TFA reduced to 2° on the right and 5° on the left, mLDFA increased to 87° on the right and 89° on the left, and medial proximal tibial angles improved to 87° on the right and 86° on the left, demonstrating significant correction of the deformity with no complications.



Pre-operative scanogram

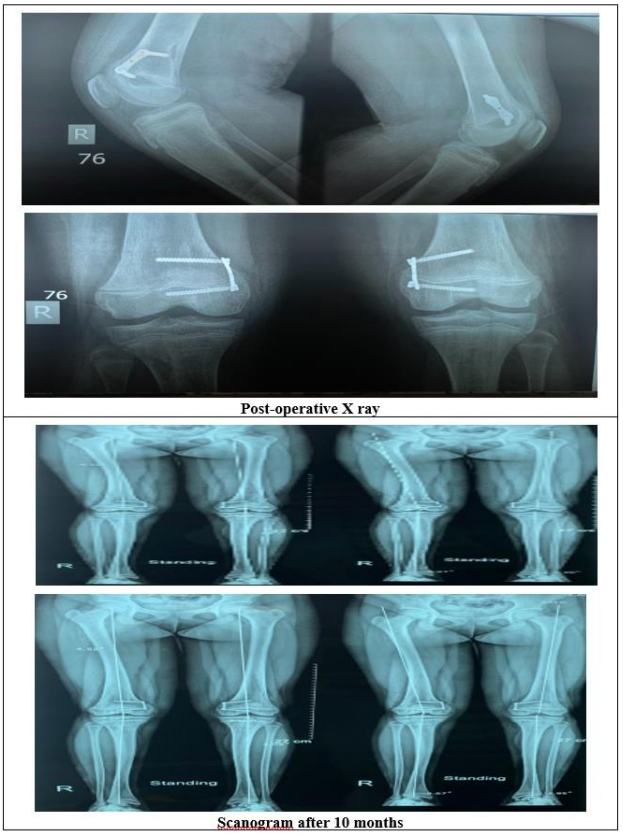


Figure 1. Shows case One

Case Two: A boy 10 years old with bilateral genu valgum treated with temporary hemiepiphysiodesis by percutaneous transphyseal screw. Clinical data: The preoperative measurements showed an intramedullary deformity (IMD) of 30 cm, which reduced to 3 cm postoperatively. The mechanical axis deviation (MAD) was +20 mm on both sides preoperatively, while postoperatively, it measured 2 degrees on the right and 5 degrees on the left. The tibiofemoral angle (TFA) was initially 20 degrees on the right and 25 degrees on the left, which improved postoperatively to 89° on the right and 87° on the left. The mLDFA was 82.5° on the right and 82° on the left preoperatively, improving to 87° and 89°, respectively, postoperatively. The medial proximal tibial angle (MPTA) remained constant at 86° on both sides pre- and postoperatively.

Preoperative scanogram

Pre operative clinical photograph

Post-operative X ray

Scanogram after 8 months

Clinical photograph after correction

Figure 2. Shows case Two

4. Discussion

The current study revealed that both the Percutaneous Screw group and 8-Plate group showed comparable results in terms of demographic and clinical characteristics, as well as biochemical parameters, with insignificant distinctions between the two groups.

The comparison of biochemical parameters between the Percutaneous Screw and 8-Plate techniques reveals no significant distinctions. Serum calcium levels were similar in both groups (9.2±0.51 vs. 9.3±0.64, p=0.713), as were phosphate (4.6±0.3 vs. 4.5±0.4, p=0.552) and alkaline phosphatase levels (250±25 vs. 260±30, p=0.330). Vitamin D levels were also closely aligned (25±5.2 vs. 27±6.6, p=0.366), as were leukocytes (7.5±0.8 vs. 7.7±0.9, p=0.609) and pH (7.38±0.03 vs. 7.39±0.04, p=0.400). Bilirubin levels, while slightly higher in the 8-Plate group (0.8±0.1 vs. 0.9±0.2), did not show a statistically significant distinction (p=0.101). The ranges for each parameter were also comparable across both groups. Overall, biochemical parameters did not differ significantly between the two techniques, indicating similar preoperative biochemical profiles.

Kumar et al.[8] reported similar rates of correction and comparable biochemical outcomes between eight-plate and staple techniques in managing idiopathic genu valgum, reinforcing the notion that biochemical parameters do not significantly differ between these methods. Additionally, Alireza Ghaznavi et al. [9] highlighted that the eight-plate technique achieved favorable results with minimal complications, while also noting comparable correction rates to other methods like reconstruction plates.

The comparison of the correction rate and implant duration between the Percutaneous Screw and 8-Plate techniques highlights significant distinctions. The correction rate for the Percutaneous Screw technique was 1.06 cm/month (± 0.12), while the 8-Plate technique had a significantly higher rate of 1.68 cm/month

(± 0.54), with a p-value of 0.004, indicating a superior correction rate for the 8-Plate technique. Regarding the duration of implant use, the Percutaneous Screw group had a mean duration of 283.22 days (± 128.37), significantly shorter than the 339.9 days (± 64.2) in the 8-Plate group, with a p-value of 0.047, suggesting that the Percutaneous Screw technique required less time for correction. The range for both parameters was also similar, with the correction rate spanning 0.75 to 1.25 cm/month in the Percutaneous Screw group and 0.81 to 2.25 cm/month in the 8-Plate group, and implant duration varying from 156 to 400 days for Percutaneous Screw and 285 to 393 days for 8-Plate. Overall, while the 8-Plate technique showed a higher correction rate, the Percutaneous Screw technique required a shorter duration of implant use.

In the same line, an investigation by Alagamy et al.[10] indicated that the 8-Plate provides an effective method for temporary hemiepiphysiodesis with a significant correction rate and minimal complications, while Alireza Ghaznavi et al.[9] highlighted that percutaneous screw techniques also yield favorable outcomes but with varying correction rates depending on specific patient factors.

The initial intermalleolar distance (IMD) was slightly higher in the 8-Plate group (10.48 cm) compared to the Percutaneous Screw group (9.23 cm), but this distinction wasn't significant ($p = 0.094$). However, the final IMD showed a significant distinction, with the 8-Plate group achieving a much smaller distance (0.5 cm) compared to the Percutaneous Screw group (2.5 cm, $p < 0.001$), indicating superior correction with the 8-Plate technique. Both groups showed significant changes in IMD, but the 8-Plate technique demonstrated a greater reduction in deformity.

Moore et al.[11] found that the 8-Plate method resulted in a notable reduction in mechanical axis deviation, with a mean correction rate significantly faster than other methods, including staples and screws. Additionally, Boero et al.[12] reported that cases treated with the 8-Plate experienced an average correction time that was approximately 30% faster than those using traditional stapling techniques, further validating the superior outcomes associated with this method. Overall, these findings align with the current study's results, highlighting the 8-Plate technique's effectiveness in correcting intermalleolar distance more efficiently than the Percutaneous Screw approach.

The comparison of complications between the Percutaneous Screw and 8-Plate techniques reveals relatively low complication rates, with some notable distinctions. In terms of failure to correct the deformity, the Percutaneous Screw group had no cases (0%), whereas 20% of the 8-Plate group experienced failure to correct, though this distinction wasn't statistically significant ($p=0.136$). Both groups had no cases of implant migration. Infection occurred in 10% of the Percutaneous Screw group, while no infections were reported in the 8-Plate group, but this distinction was also not statistically significant ($p=0.305$). Lastly, overcorrection was observed in 10% of the 8-Plate group, but none in the Percutaneous Screw group, with insignificant distinction among the groups ($p=0.305$). Overall, while complications such as failure to correct, infection, and overcorrection were rare, the 8-Plate technique showed a slightly higher incidence of these issues compared to the Percutaneous Screw technique, though the distinctions were not statistically significant.

A study by Alireza Ghaznavi et al.[9] found that the 8-Plate technique had a failure rate of approximately 3% for correction, while complications such as overcorrection were also noted but were manageable without significant intervention.

4. Conclusion

Both the Percutaneous Screw and 8-Plate techniques show similar results in terms of demographic and clinical characteristics, but the 8-Plate technique has a higher correction rate and smaller final intermalleolar distance, indicating superior deformity correction. Both techniques have a low incidence of complications, with the 8-Plate group having a slightly higher risk of failure, overcorrection, and infection.

Disclosure

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