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Infratuberositary Slope-Decreasing Anterior Closed Wedge Proximal Tibial Osteotomy is Safe and Shows Rapid Bone Healing

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Investigation performed at the Centre for Sports Orthopedics and Special Joint Surgery, Orthopedic Hospital Markgröningen, Germany, and the Department of Orthopedics and Traumatology, Klinikum Bamberg, Germany.

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Affiliations + Disclosures

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supratuberositary approach

‚tubercle-sparing' approach

transtuberositary approach

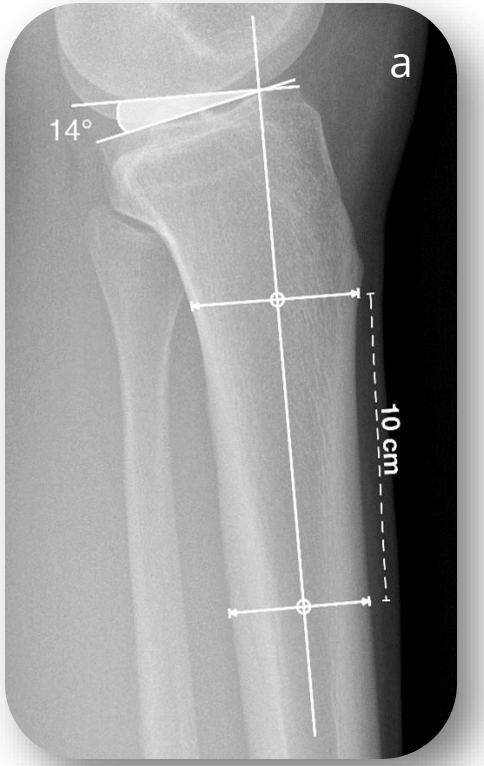
Purpose

Different techniques of slope-decreasing anterior closed-wedge proximal tibial osteotomy (ACW-PTO) have been described. The purpose of this study was to determine the peri- and post-operative complication rate and obtain data on bone healing in ACW-PTO with an infratuberositary approach.

Study Design: Case series with pooled data of two centres.
Level of Evidence: Level 4.

infratuberositary approach

Methods



Pre- and postoperative lateral x-rays (a, b) of an infatuberositary anterior closed wedge proximal tibial osteotomy and measurment of the posterior tibial slope according to the proximal anatomical axis (Dejour & Bonnin, JBJS Br, 1994).

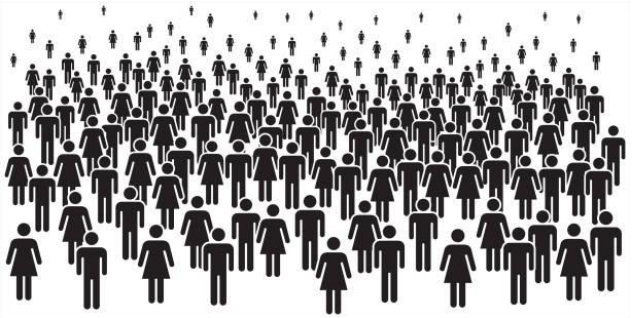
A total of 170 consecutive ACW-PTO of two sports-orthopaedic centres were retrospectively evaluated (97 and 73, respectively). Routine follow-up was performed after 6 weeks and was available in 166 cases (97.7%). Medical charts and x-rays of these cases were reviewed with regard to technique-specific complications. Lateral x-rays (n = 155) at 6 weeks post-operatively were evaluated with regard to bone healing (completely healed, partially healed or with no or delayed signs of bone healing).
A multivariate binary logistic regression was performed to detect factors that influence bone healing.

Methods: Demographic data

	Centre 1	Centre 2	Pooled data
Number of cases	97	73	170
Age (years)	29.6 ± 8.3	31.6 ± 10.2	30.4 ± 9.2
	(14.2–54.3)	(15.0–58.1)	(14.2–58.1)
Sex			
Male	60 (61.9%)	46 (63.0%)	106 (62.4%)
Female	37 (38.1%)	27 (37.0%)	64 (37.6%)
Side			
Left	48 (49.5%)	33 (45.2%)	81 (47.6%)
Right	49 (50.5%)	40 (54.8%)	89 (52.4%)
BMI (kg/m²)	25.5 ± 4.5	25.8 ± 4.4	25.6 ± 4.4
	(14.0–41.7)	(14.1–41.3)	(14.0–41.7)
Smoker	30 (30.9%)	26 (35.6%)	56 (32.9%)
Number of previous ACL reconstructions			
0 (Primary ACL injury)	10 (10.3%)	10 (13.7%)	20 (11.8%)
1	46 (47.4%)	27 (37.0%)	73 (42.9%)
2	34 (35.1%)	30 (41.1%)	64 (37.6%)
3	6 (6.2%)	6 (8.2%)	12 (7.1%)
4	1 (1.0%)		1 (0.6%)

Note: Data presented as number (percentage) or mean ± standard deviation (range).
Abbreviations: ACL, anterior cruciate ligament; BMI, body mass index.

n = 170



Methods: Surgical details

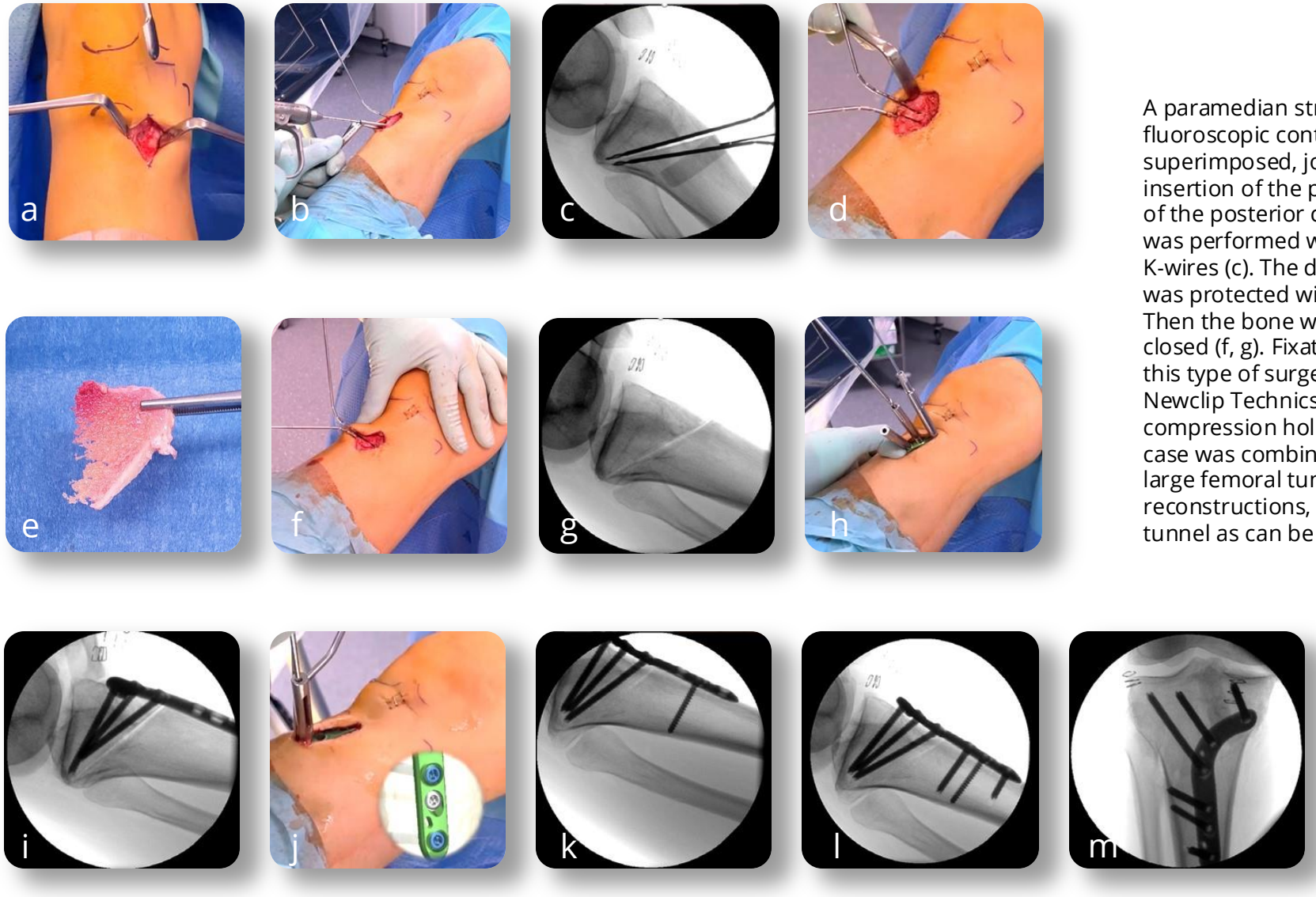
	Centre 1 97	Center 2 73	Pooled data 170
Type of surgery: ACW-PTO+			
Bone grafting of the tunnels	59 (60.8%)	50 (68.5%)	109 (64.1%)
ACLR	37 (38.1%)		37 (21.8%)
No further procedures	1 (1.0%)	23 (31.5%)	24 (14.1%)
Fixation method			
Only screws		1 (1.4%)	1 (0.6%)
Only plate	30 (30.9%)		30 (17.6%)
Lag-screw(s) + plate	4 (4.1%)	34 (46.6%)	38 (22.4%)
Plate with dynamic compression	63 (64.9%)	38 (52.1%)	101 (59.4%)
Extent of the osteotomy			
Height of osteotomy wedge (mm)	9.5 ± 1.8		
Angle of the wedge	(6.0–19.0)	8.1 ± 1.7	-
		(6.0–16.0)	
Posterior tibial slope (°)[a]			
Preoperatively	15.0 ± 2.2	15.1 ± 2.9	15.0 ± 2.5
	(10.9–22.7)	(11.0–30.0)	(10.9–30.0)
Post-operatively	7.0 ± 2.0	7.2 ± 1.6	7.1 ± 1.8
	(1.9–13.7)	(4.0–14.0)	(1.9–14.0)
Delta	8.0 ± 1.8	7.9 ± 1.7	8.0 ± 1.7
	(4.7–13.0)	(6.0–16.0)	(4.7–16.0)
Concomitant distal femoral osteotomy	2 (2.1%)	2 (2.7%)	4 (2.4%)
Concomitant meniscus and cartilage surgery			
Medial meniscus			
Root refixation	2 (2.1%)		2 (1.2%)
Refixation/suture	22 (22.9%)	1 (1.4%)	23 (13.6%)
Partial resection	22 (22.9%)	6 (8.2%)	28 (16.6%)
Lateral meniscus			
Root refixation	1 (1.0%)		1 (0.6%)
Refixation/suture	12 (12.4%)	1 (1.4%)	13 (7.6%)
Partial resection	19 (19.6%)	6 (8.2%)	25 (14.7%)
Microfracture or ACI	5 (5.2%)	1 (1.4%)	6 (3.5%)
Graft choice in concomitant ACLR ($n = 37$)		-	-
Hamstrings ipsilateral	8 (21.6%)		
Hamstrings contralateral	8 (21.6%)		
Quadriceps ipsilateral	20 (54.1%)		
Allograft	1 (2.7%)		
Anterolateral reconstruction in cases with concomitant ACLR ($n = 37$)	31 (83.7%)	-	-

Note: Data presented as number (percentage) or mean ± standard deviation (range).
Abbreviations: ACI, autologous chondrocyte implantation; ACLR, anterior cruciate ligament reconstruction; ACW-PTO, anterior closed wedge proximal tibial osteotomy.

Methods: Evaluation of bone healing

Evaluation of bone healing on lateral x-rays at 6 weeks postoperatively: completely healed (a), partially healed (b) and no or delayed signs of bone healing (c).

Surgical technique



A paramedian straight medial incision was created (a). Under fluoroscopic control on a straight lateral x-ray (posterior tibial condyles superimposed, joint gap visible) two K-wires were inserted inferior to the insertion of the patellar tendon aiming at the lower half of the insertion of the posterior cruciate ligament at the dorsal tibia (b, c). The osteotomy was performed with two parallel saw cuts under the guidance of the K-wires (c). The distal part of the superficial medial collateral ligament was protected with a radiolucent retractor.
Then the bone wedge was removed (d, e). The osteotomy was gradually closed (f, g). Fixation was performed with a specifically designed plate for this type of surgery (Activmotion S® deflexion osteotomy plate Size 2, Newclip Technics) allowing fragment compression over a dynamic compression hole on the distal part of the plate (h–m). The presented case was combined with bone grafting of the tunnels because of two large femoral tunnels of previous anterior cruciate ligament reconstructions, but the technique would allow the placement of a tibial tunnel as can be seen on the x-rays.

Results: Complications

1 case of superficial wound healing problems progressing to infection (revision surgery, plate exchange)

1 case of delayed bone healing (plate exchange with revision ACL reconstruction 4 months post surgery)

Overall complication rate: 2 out of 166 – 1.2%

Results: Bone healing at 6 weeks

completely: 104/166 – 67.1%

partially: 50/166 – 32.3 %

delayed: 1/166 – 0.6%

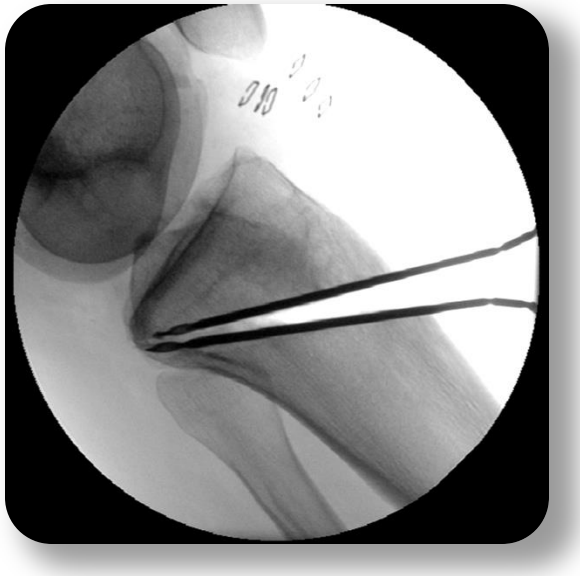
completely closed osteotomy
+ compression:
84% completely healed

Predictors of complete bone healing (multivariate regression)

Predictor variable	OR	95% CI	*p*
Age, per year increase	0.964	0.924–1.006	0.095
Sex, female vs. male	1.820	0.798–4.154	0.095
BMI, per unit increase	0.929	0.853–1.012	0.092
Smoking status, yes vs. no	1.177	0.522–2.656	0.695
Completely closed osteotomy, yes vs. no	3.532	1.525–8.179	**0.003**
Compression on osteotomy, yes vs. no	2.521	1.117–5.688	**0.026**

Abbreviations: BMI, body mass index; CI, confidence interval; OR, odds ratio.

Conclusion



Anterior closed wedge proximal tibial osteotomy
using an infratuberositary approach is very safe
with regard to complication rate and shows rapid bone healing.

The osteotomy should be completely closed and
compression should be applied for optimal bone healing.

KNEE OSTEOTOMY

Knee Surgery, Sports Traumatology, Arthroscopy WILEY

Infratuberositary slope-decreasing anterior closed wedge proximal tibial osteotomy is safe and shows rapid bone healing

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Abstract

Purpose: Different techniques of slope-decreasing anterior closed-wedge proximal tibial osteotomy (ACW-PTO) have been described. To determine the peri- and post-operative complication rate and obtain data on bone healing in ACW-PTO with an infratuberositary approach.

Methods: A total of 170 consecutive ACW-PTO of two sports-orthopaedic centres were retrospectively evaluated (97 and 73, respectively). Routine follow-up was performed after 6 weeks and was available in 166 cases (97.7%). Medical charts and x-rays of these cases were reviewed with regard to technique-specific complications. Lateral x-rays ($n = 155$) at 6 weeks post-operatively were evaluated with regard to bone healing (completely healed, partially healed or with no or delayed signs of bone healing). A multivariate binary logistic regression was performed to detect factors that influence bone healing.

Results: There was one case with haematoma and superficial wound-healing problems after 5 weeks with progression to a deep wound infection and revision surgery (plate exchange) at 11 weeks after the index surgery. One case with delayed bone healing was treated with plate exchange combined with revision anterior cruciate ligament reconstruction after 4 months. The further course of both cases was uneventful. No other complications were observed. Therefore, the overall complication rate was 1.2% (2 out of 166). Radiologic evaluation at 6 weeks showed complete healing in 104 cases (67.1%), partial healing in 50 cases (32.3%) and delayed healing only in the aforementioned case (0.6%), respectively. All cases of partial healing showed complete healing at 12 weeks. In regression analysis, a completely closed osteotomy (odds ratio [OR] = 3.5, $p = 0.003$) and compression of the osteotomy (OR = 2.5, $p = 0.026$) were significantly associated with complete bone healing at 6 weeks.

Conclusions: ACW-PTO using an infratuberositary approach is very safe with regard to complication rate and shows rapid bone healing. The

Abbreviations: ACL, anterior cruciate ligament; ACLR, anterior cruciate ligament reconstruction; ACW-PTO, anterior closed wedge proximal tibial osteotomy; BMI, body mass index; HTO, high tibial osteotomy; ICC, intra-class correlation coefficient; OR, odds ratio; PTS, posterior tibial slope.

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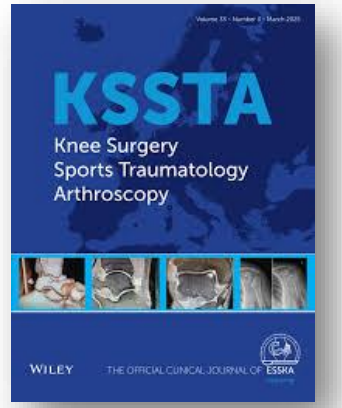

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