



Clinical Data Book

A guide to SilverHawk Clinical Studies

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Introduction

Atherectomy has experienced increased interest as a treatment in the peripheral arteries. Over the last few years, several clinicians have gained substantial experience in using this endovascular technique also called plaque excision. Recent data indicates that plaque excision is an effective solution for patients suffering from Peripheral Artery Disease (PAD) that can result in excellent patency, limb salvage, wound healing and pain reduction¹. Furthermore, some clinical data suggests that atherectomy may be a valuable alternative to stenting considering reports of stent fractures in femoropopliteal arteries².

As a leader in peripheral vascular disease technology, ev3 remains committed to conducting clinical studies using the SilverHawk™ Plaque Excision Device. In 2008, ev3 began investing in several clinical trials as a part of their strategy to continue enhancing the data available on atherectomy.

The following booklet is a summary of the published clinical trials and journal articles regarding the SilverHawk Plaque Excision Device.

Reference:

¹ McKinsey, James F. MD. "Novel Treatment of Patients With Lower Extremity Ischemia: Use of Percutaneous Atherectomy in 579 Lesions." *Annals of Surgery*. October 2008; Vol248, Number4: 519-528.

² Thomas Zeller, MD. "Long-Term Results after Directional Atherectomy of Femoro-Popliteal Lesions." *Journal of the American College of Cardiology*. 2006; 48; 1573-1578.

SilverHawk Data Summary

SilverHawk Data Summary		
Trial	Sample Size	Results
Zeller	84	<ul style="list-style-type: none">• Primary patency at 1 year:<ul style="list-style-type: none">— 84% in de novo lesions— 54% in restenotic lesions and in-stent restenosis
Ramaiah	601	<ul style="list-style-type: none">• 80% freedom from TLR at 1 year• ~ 98% procedure success and ~ 5% complication rate
Kandzari	69	<ul style="list-style-type: none">• 99% procedural success and 82% limb salvage at 6 months
Zeller	36	<ul style="list-style-type: none">• At 2 years, 60% primary patency and 80% secondary patency
Keeling	60	<ul style="list-style-type: none">• 61.7% primary patency at 1 year and 86.2% limb salvage
McKinsey	275	<ul style="list-style-type: none">• 62.2% primary patency at 1 year• 89.7% limb salvage

Long-Term Results after Directional Atherectomy of Femoro-Popliteal Lesions

Thomas Zeller, MD
Germany

Objective:

To evaluate the long-term results after directional atherectomy using the SilverHawk device on femoro-popliteal lesions.

Design Summary:

- 84 patients with 100 legs and 131 lesions with peripheral occlusive disease were treated between June 2002 and May 2004.
- Rutherford categories 2-5 were included in this prospective single center registry.
- 34% de novo lesions, 33% native vessel restenoses, and 33% in-stent restenosis.

Study Endpoints and Definitions:

- Primary patency is defined as freedom of restenosis >50% calculated by duplex ultrasound (PSVR > 2.4) without any reintervention at the level of the target lesion at the time of follow-up visit.
- Secondary patency is defined as freedom of restenosis >50% at the time of follow up visit after reintervention in case of restenosis or reocclusion of the target lesion before the follow-up visit.
- Technical success is defined as less than or equal to 50% residual stenosis after atherectomy.

Results:

- Atherectomy on its own led to technical success in 97% of the cases.
- No amputation occurred in de novo lesions.

	Primary Patency		Secondary Patency		TLR	
	12 months	18 months	12 months	18 months	12 months	18 months
De Novo	84%	73%	100%	89%	16%	22%
Native Vessel Restenosis	54%	42%	93%	67%	44%	56%
In-Stent Restenosis	54%	49%	91%	79%	47%	49%

Long-Term Results after Directional Atherectomy of Femoro-Popliteal Lesions *(continued)*

Authors' Conclusion:

Long-term technical and clinical results after directional atherectomy of femoro-popliteal lesions are in favor of de novo lesions compared with restenotic lesions.

Reference:

Thomas Zeller, MD, Aljoscha Rastan, MD, Sebastian Sixt, MD, Uwe Schwarzwälder, MD, Thomas Schwarz, MD, Ulrich Frank, MD, Karlheinz Bürgelin, MD, Christian Müller, MD,† Uwe Rothenpieler, MD, Peter-Christian Flügel, MD, Gunnar Tepe, MD,‡ Franz-Josef Neumann, MD, FACC.

Bad Krozingen and Tübingen, Germany; and Basel, Switzerland

Long-Term Results after Directional Atherectomy of Femoro-Popliteal Lesions

JACC 2006; 48(8): 1573-1578

Midterm Outcomes from the TALON Registry: Treating Peripherals with SilverHawk: Outcomes Collection

Venkatesh Ramaiah, MD
Arizona Heart Hospital

Objective:

The goal of this research was to determine midterm clinical outcomes among patients with lower extremity peripheral arterial disease who underwent revascularization with catheter-based plaque excision (PE).

Design Summary:

- 601 patients underwent PE to treat 1258 atherosclerotic lesion in 748 limbs.
- 19 centers participated over an 18 month period in 2003-2006.
- 74% of the patient population was Rutherford category 2-4, 15% was category 5-6. 51.5% were diabetic and 67.1% of the population had a history of smoking. 97% had a history of claudication.
- 74.8% ATK, 25.2% BTK, 48.6% SFA, 14.5% Popliteal, 12.2% TPT/Peroneal.
- Follow-up included acute and long-term complications as well as target lesion revascularization (TLR) at 6 and 12 months.

Study Endpoints and Definitions:

- The primary efficacy endpoint was target lesion revascularization (TLR) at 6 and 12 months following the procedure.
 - TLR was defined as any revascularization or amputation procedure that involved the PE-treated lesion segment.
- Secondary endpoints included device success, defined as $\leq 50\%$ final residual diameter stenosis of the target lesion and procedural success referring to \leq final residual diameter stenosis with no occurrence of death, MI, amputation, (including planned amputations), TLR, or major bleeding within 30 days of the procedure.

Results:

- Freedom from TLR was 90% at 6 months and 80% at 12 months.
- Procedural success occurred 97.6% of the time, device success in 94.7% of lesions.
- Nearly three quarters of the lesions did not require adjunctive therapy and stent placement following PE occurred in only 79 of the 1258 lesions.

Midterm Outcomes from the TALON Registry: Treating Peripherals with SilverHawk: Outcomes Collection

(continued)

Authors' Conclusion:

- These findings demonstrate a high rate of immediate procedural success in both femoropopliteal and tibioperoneal vessels, with limited use of adjunctive therapy. In addition, these results represent favorable midterm clinical outcomes across a challenging patient and lesion cohort. Further comparisons are warranted between PE and other endovascular modalities to treat lower extremity PAD.

Considerations:

- Over half of the participants in the study were diabetic thus atherectomy can be effectively used in a traditionally difficult-to-treat population of patients.

Reference:

Venkatesh Ramaiah, MD;¹ Roger Gammon, MD;² Stefan Kiesz, MD;³ Joseph Cardenas, MD;⁴ John Paul Runyon, MD;⁵ Peter Fail, MD;⁶ Craig Walker, MD;⁶ David E. Allie, MD;⁷ Jack Chamberlin, MD;⁸ Maurice Solis, MD;⁹ Lawrence Garcia, MD;⁹ and David Kandzari, MD.¹⁰

¹Arizona Heart Hospital, Phoenix, Arizona, USA. ²Austin Heart Hospital, Austin, and ³San Antonio Endovascular and Heart Institute, San Antonio, Texas, USA. ⁴Ohio Heart Hospital, Cincinnati, Ohio, USA. ⁵Terrebonne General Medical Center, Houma, and ⁶Cardiovascular Institute of the South, Lafayette, Louisiana, USA. ⁷Alexian Brothers Hospital, Elk Grove Village, Illinois, USA. ⁸Macon Cardiovascular Institute, Macon, Georgia, USA. ⁹Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA. ¹⁰Clinical Research Institute, Durham, North Carolina, USA.

Midterm Outcomes from the TALON Registry: Treating Peripherals with SilverHawk: Outcomes Collection

Journal Endovascular Therapy 2006; 13:592-602

Procedural and Clinical Outcome with Catheter-Based Plaque Excision in Critical Limb Ischemia

David E. Kandzari, MD
Duke Clinical Research Institute

Objective:

To examine the safety and efficacy of catheter-based plaque excision as an alternative therapy to surgery, conventional angioplasty, and / or stenting in high-risk patients with critical limb ischemia (CLI).

Design Summary:

- 69 patients with CLI involving 76 limbs were enrolled; 78% of these patients with diabetic and 53% were smokers, 93% of patients were Rutherford category 5 and the other 7% were Rutherford 6.
- This research was conducted between August 2003-2004 and was a prospective evaluation of consecutive patients with CLI who were treated with PE.
- Follow-up was conducted at 30 days, 3 and 6 months.
- Difficult/complex lesions results:
 - Average lesion length = 6.5 cm
 - CTO = 34%
 - Moderate/severe calcification = 80%

Study Endpoints and Definitions:

- Primary endpoint: Major adverse event rate at 30 days, defined as death, MI, unplanned amputation or TLR.
- Secondary endpoint: Avoidance of planned or unplanned amputation and the performance of less extensive amputation than initially intended through 6 months.
- Procedural success: <50% residual stenosis without major in-hospital complications.
- Device success: <50% final residual diameter stenosis of target lesion.

Procedural and Clinical Outcome with Catheter-Based Plaque Excision in Critical Limb Ischemia *(continued)*

Results:

- PE was the primary therapy for 158 of the 159 lesions.
 - Device success was achieved in 99% of the procedures, and atherosclerotic tissue was retrieved in all plaque excision procedures.
 - The primary endpoint was achieved with zero MAEs.
 - Procedural success was achieved in 99% of patients.
- Immediate and short-term limb salvage rates were 92% at 30 days and 82% at 6 months.
 - Only 11% of lesions required adjunctive angioplasty and only 6% of lesions required adjunctive stenting.
- 78% of patients were diabetics with no statistically significant difference between diabetic vs. non-diabetic outcomes in TLR, amputation, or major adverse event rates.

Authors' Conclusion:

- Among patients with co-morbidity that poses a high risk, such as CLI, catheter-based plaque excision may be considered a suitable alternative for limb preservation.
- Plaque excision enables atherectomy of atherosclerotic tissue to achieve greater luminal gain without plaque displacement, or vessel dilatation and injury.

Thomas Zeller, MD

Reference:

David E. Kandzari, MD¹; R. Stefan Kiesz, MD²; David Allie, MD³; Craig Walker, MD⁴; Peter Fail, MD⁵; Venkatesh G. Ramaiah, MD⁶; Joseph Cardenas, MD⁷; Jose Vale, MD⁸; Atul Chopra, MBBS⁹; and Roger S. Gammon, MD¹⁰

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Procedural and Clinical Outcome with Catheter-Based Plaque Excision in Critical Limb Ischemia

Journal of Endovascular Therapy 2006; 13:12-22

Two Year Results after Directional Atherectomy of Infrapopliteal Arteries with the SilverHawk Device

Germany

Objective:

To report the 12 and 24 month results after directional atherectomy (DA) of below-the-knee (BTK) arterial lesions with the SilverHawk Device.

Design Summary:

- 49 BTK lesions in 36 patients with peripheral occlusive disease of the lower limbs were treated with directional atherectomy.
- 19 (53%) of the limbs were classified with Rutherford-Becker 4 or 5 ischemia.
- 61% of patients had diabetes, 39% were smokers.

Study Endpoints and Definitions:

- The primary endpoint was primary patency after 12 and 24 months.
- Primary patency was defined as freedom from at least 70% restenosis without any reintervention of target lesion at follow-up as derived from duplex.
- Secondary endpoints were secondary patency rates, TLR rates and complication rates at 12 and 24 months.

Results:

	12-Month Results	24-Month Results
Primary patency	67% (31 / 46)	60% (30 / 46)
Secondary patency	91% (42 / 46)	80% (32 / 40)
TLR	24% (11 / 46)	32.5% (11 / 40)
ABI	0.72 ± 0.71	0.86 ± 0.14

- One major complication occurred and was treated with a stent and 2 minor complications occurred and was treated with hemoglobin.

Authors' Conclusion:

Two Year Results after Directional Atherectomy of Infrapopliteal Arteries with the SilverHawk Device

(continued)

Atherectomy offers promising acute and long-term clinical results in the treatment of below-the-knee arteries, especially in patients with critical limb ischemia. A low complication rate can be obtained as well.

Considerations:

- A promising long-term clinical efficacy in BTK CLI lesions was demonstrated in a particularly sick patient population.
 - 100% limb salvage
 - Low 2- year mortality rate: 8.3%

W. Brent Keeling, MD

Reference:

Thomas Zeller, MD¹, Sebastian Sixt, MD¹, Uwe Schwarzwälder, MD¹, Thomas Schwarz, MD¹, Ulrich Frank, MD¹, Karlheinz Bürgelin, MD¹, Volker Pochert, MD¹, Christian Müller, MD², Elias Noory, MD¹, Hans Krankenberg, MD³, Kirsten Hauswald, MD¹, Franz-Josef Neumann, MD¹, and Aljoscha Rastan, MD¹

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Two-year Results After Directional Atherectomy of Infrapopliteal Arteries With the Silverhawk Device

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Plaque Excision with the SilverHawk Catheter: Early results in patients with claudication or critical limb ischemia

Tampa, Florida

Objective:

To detail the early experience after infrainguinal atherectomy using the SilverHawk Plaque Excision Catheter for the treatment of symptomatic peripheral vascular disease.

Design Summary:

- 60 patients, 66 limbs, 70 plaque excision procedures; 45% had diabetes, 36.7% were smokers and 10% were in end-stage renal failure requiring dialysis.
- 2/3 of patients were TASC C or D.
- Patients were enrolled from August 2004-January 2006.
- Prospective registry, all patients enrolled were previously treated with SilverHawk.

Results:

- Initial technical success rate = 87.1%.
- Overall primary patency = 61.7%; secondary patency = 76% (derived from duplex ultrasound).
- Patients with CLI and more complex lesions (TASC C or D): 1 year limb salvage rate = 86.2%.
- Study focused primarily on difficult-to-treat patient population.
- Almost half of the patients were treated as outpatients and 60% spent less than 2 days in the hospital.

	TASC A or B		TASC C or D	
	6 months	12 months	6 months	12 months
Primary patency	100%	100%	64%	36%
Secondary patency	100%	100%	4%	62%

Authors' Conclusion:

Plaque Excision with the SilverHawk Catheter: Early results in patients with claudication or critical limb ischemia

(continued)

Plaque excision with the SilverHawk Device is feasible in a wide spectrum of patients with peripheral arterial occlusive disease. Initial technical success rates are high, and periprocedural morbidity and mortality rates are lower than surgical bypass.

Considerations:

- The patients in this study had particularly advanced peripheral vascular disease however the results were promising especially the limb salvage rate for TASC C or D patients.

James F. McKinsey, MD

Reference:

W. Brent Keeling, MD, Murray L. Shames, MD, Patrick A. Stone, MD, Paul A. Armstrong, DO, Brad L. Johnson, MD, Martin R. Back, MD, and Dennis F. Bandyk, MD,

Tampa, Fl

Plaque Excision with the SilverHawk Catheter: Early results in patients with claudication or critical ischemia

Journal of Endovascular Therapy 2007; 45(1):25-31

Novel Treatment of Patients With Lower Extremity Ischemia: Use of Percutaneous Atherectomy in 579 Lesions

New York Presbyterian Hospital

Objective:

Treatment for lower extremity peripheral arterial disease usually results in diminished patency. An alternative to standard angioplasty and stent is the excision of the obstructing arterial plaque utilizing a minimally invasive device, the SilverHawk.

Design Summary:

- 579 lesions were treated in 275 patients; 63.3% of patients were CLI and 36.7% were claudicants, 67.6% had diabetes and 46.2% were smokers.
- Study period March 2004 – October 2007 (Prospective Database).
- Procedural success defined as residual stenosis of < 30% by angiography.
- Primary atherectomy was solely directional atherectomy,
- Assisted atherectomy was defined as primarily atherectomy requiring adjunctive therapy with angioplasty (76%) or stent placement (23.5%).
- Adjunctive therapy was primarily angioplasty (2.9%) but due to significant residual stenosis or intimal plaque patients underwent adjunctive atherectomy.

Results:

	12 Months	18 Months
Primary Patency	62.2%	52.7%
Secondary Patency	80.3%	75%
Limb Salvage	93.1%	92.4%

	Primary Atherectomy		Assisted Atherectomy		Adjunctive Atherectomy	
	12 Months	18 Months	12 Months	18 Months	12 Months	18 Months
Primary Patency	64.2%	53.5%	60.5%	53.8%	48.1%	24.1%
Secondary Patency	79.9%	75.7%	82.2%	75.0%	90.9%	90.0%
Limb Salvage	89.6%	87.2%	89.8%	89.8%	90.9%	90.9%

Novel Treatment of Patients With Lower Extremity Ischemia: Use of Percutaneous Atherectomy in 579 Lesions *(continued)*

	Primary Patency		Secondary Patency	
	12 Months	18 Months	12 Months	18 Months
TASC A	71.4%	58.6%	87.0%	79.8%
TASC B	69.7%	57.3%	86.0%	73.6%
TASC C	56.4%	50.6%	80.1%	80.1%
TASC D	53.7%	47.8%	74.1%	72.2%

Authors' Conclusion:

- Endovascular intervention with SilverHawk Directional Atherectomy can result in excellent secondary patency and limb salvage for patients with claudication and CLI.
- Atherectomy is a viable option for the treatment of lower extremity ischemia.

Reference:

James F. McKinsey, MD, Lee Goldstein, MD, Habib U. Khan, MD, Ashley Graham, BS, Combiz Rezeyat, MD, Nicholas J. Morrissey, MD, Elliott Sambol, MD, and K. Craig Kent, MD

From the Division of Vascular Surgery, New York Presbyterian Hospital, Columbia University College of Physicians and Surgeons and Weill Medical College of Cornell University, New York NY

Novel Treatment of Patients With Lower Extremity Ischemia: Use of Percutaneous Atherectomy in 579 Lesions

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