

+ Evidence in focus

REDAPT[◇] Revision
Femoral Stem –
stable fixation with
low subsidence at
1 year

Revision total hip arthroplasties (rTHAs) are set to increase as younger, more active patients, outlive their implants^{1,2}



In a recent study, survivorship of primary THA was

 **86%**
at 15 years⁴

“Despite the success of primary THA, failure and revision continue to pose a major challenge for orthopedists while persisting as a significant economic burden on the healthcare system.”³

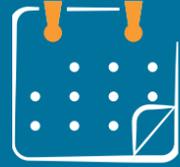
Compared to primary THA, rTHA is associated with:

**52
minutes**



longer
operative
time⁵

**4
days**



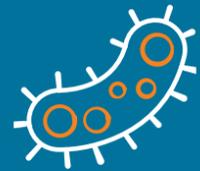
increased
length of
stay⁵

76%
increased
costs⁵



6.8%

more
infections⁵



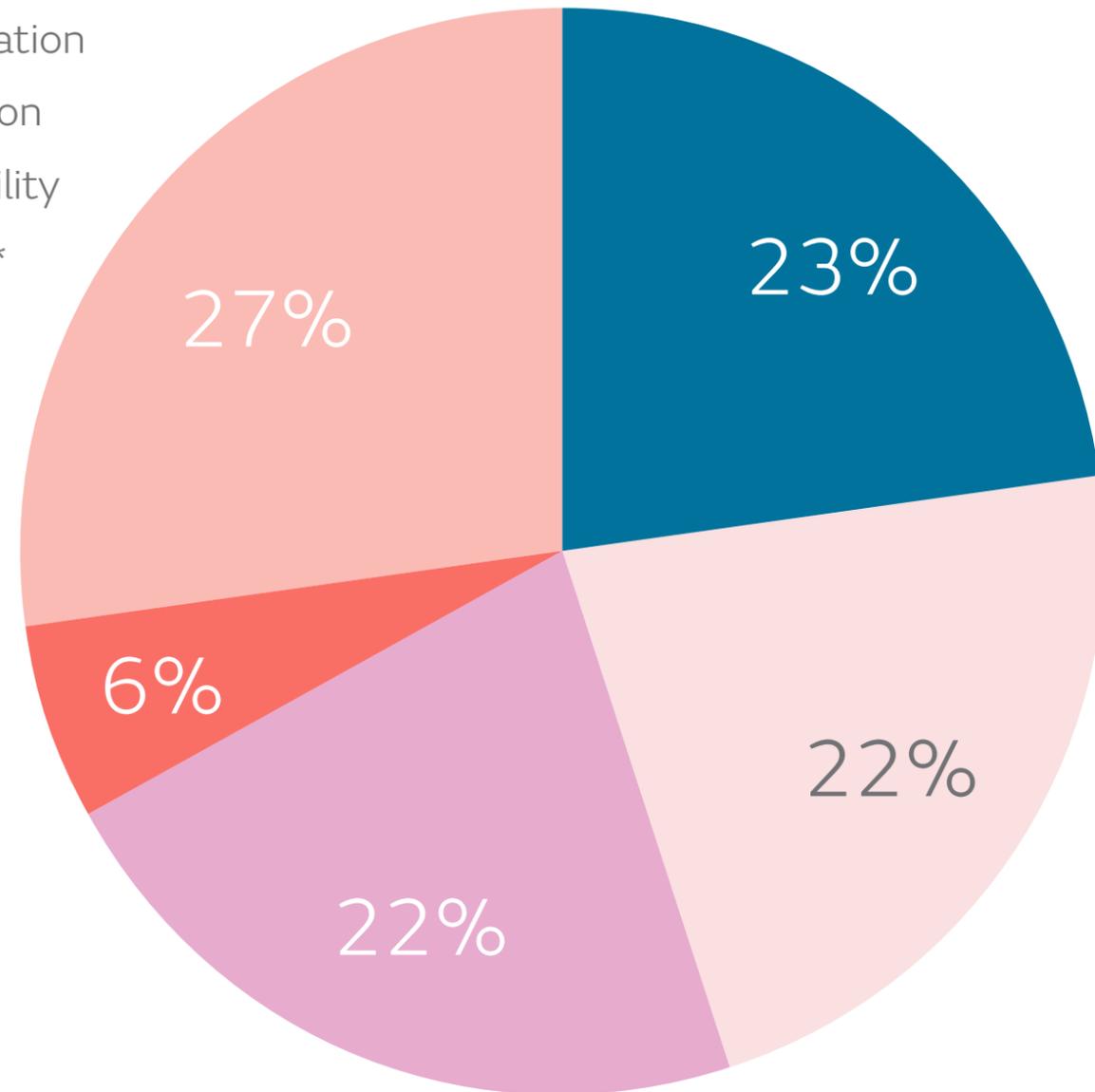
**Less
impact**

on patient-reported
outcomes⁵



Key reasons for rTHA failure⁶

- Aseptic loosening
- Dislocation
- Infection
- Instability
- Other*



Aseptic loosening is linked to subsidence in rTHA^{7,8}

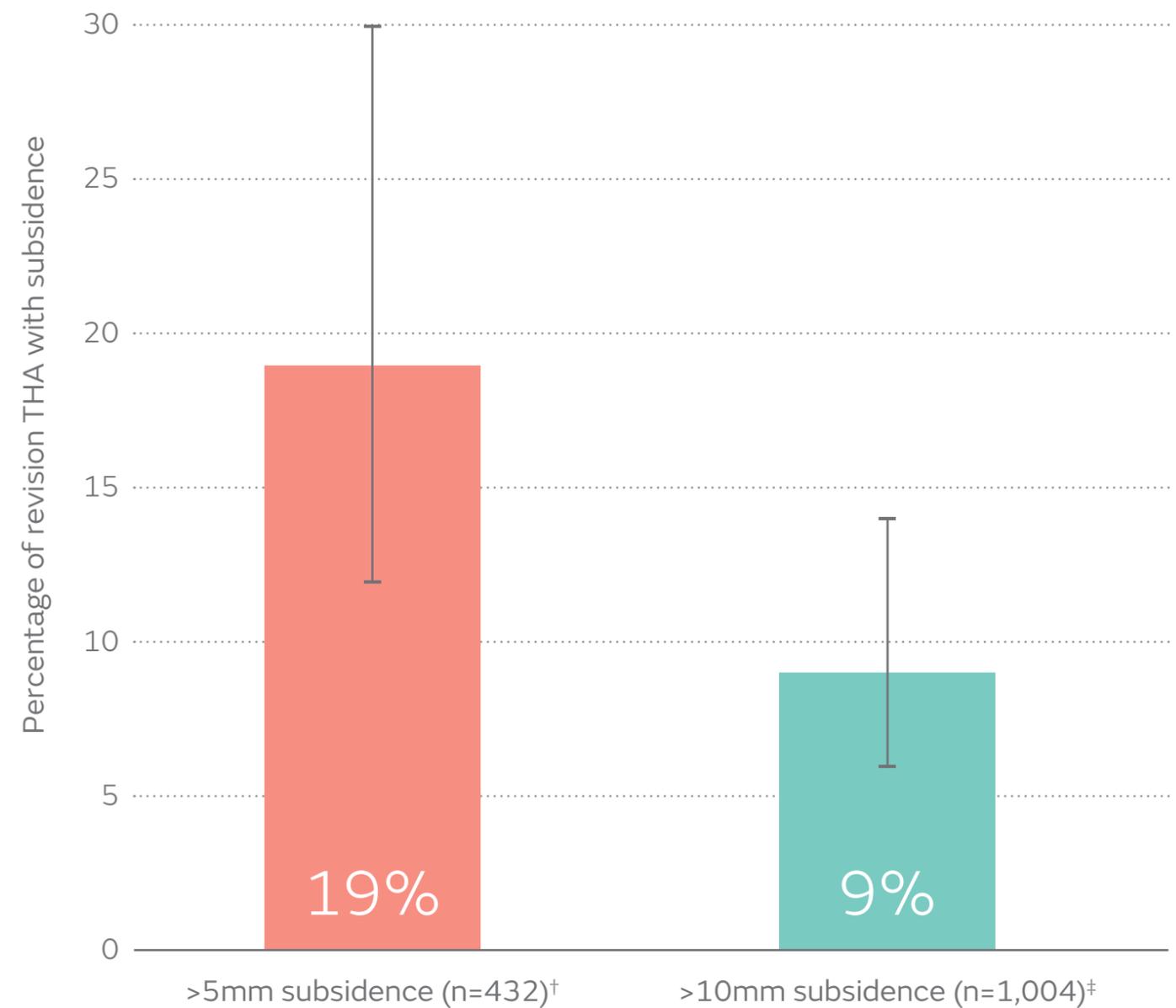


*Includes mechanical complications, bone fracture, component fracture, pain, and wear.

Subsidence rates with a frequently used nonmodular revision stem

- Subsidence $\geq 10\text{mm}$ has been shown to be a risk factor for re-revision of the femoral component⁸
- A recent systematic literature review and meta-analysis determined subsidence rates for the Wagner SL Revision™ stem (Zimmer Biomet, Warsaw, IN, USA)^{9*}
 - Search performed on March 27, 2020
 - Search term: ‘Wagner SL’
 - Peer-reviewed manuscripts published from 2000
 - Mean follow-up ranged from 2.0 to 15.7 years
 - English language studies
- Wagner SL stem subsided $>5\text{mm}$ in $\sim 19\%$ of patients and $>10\text{mm}$ in $\sim 9\%$ of patients⁹

Subsidence rates (95% CI) associated with Wagner SL Revision Stem⁹

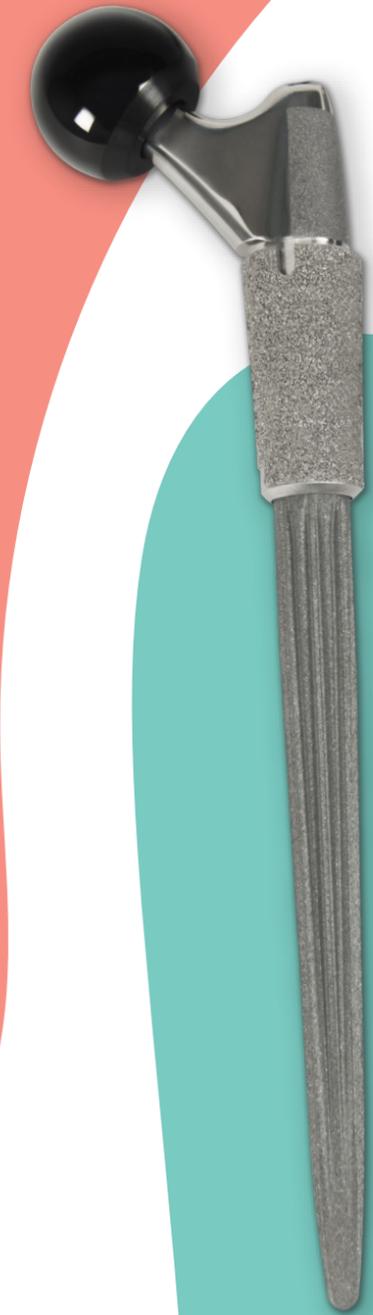


*See Appendix for studies included. †Number of studies, 8 (mean follow-up: 2.1–13.9 years).

‡Number of studies, 16 (mean follow-up: 2.0–15.7 years).

REDAPT[◇] Revision Femoral Stem

**Stability without
compromise**

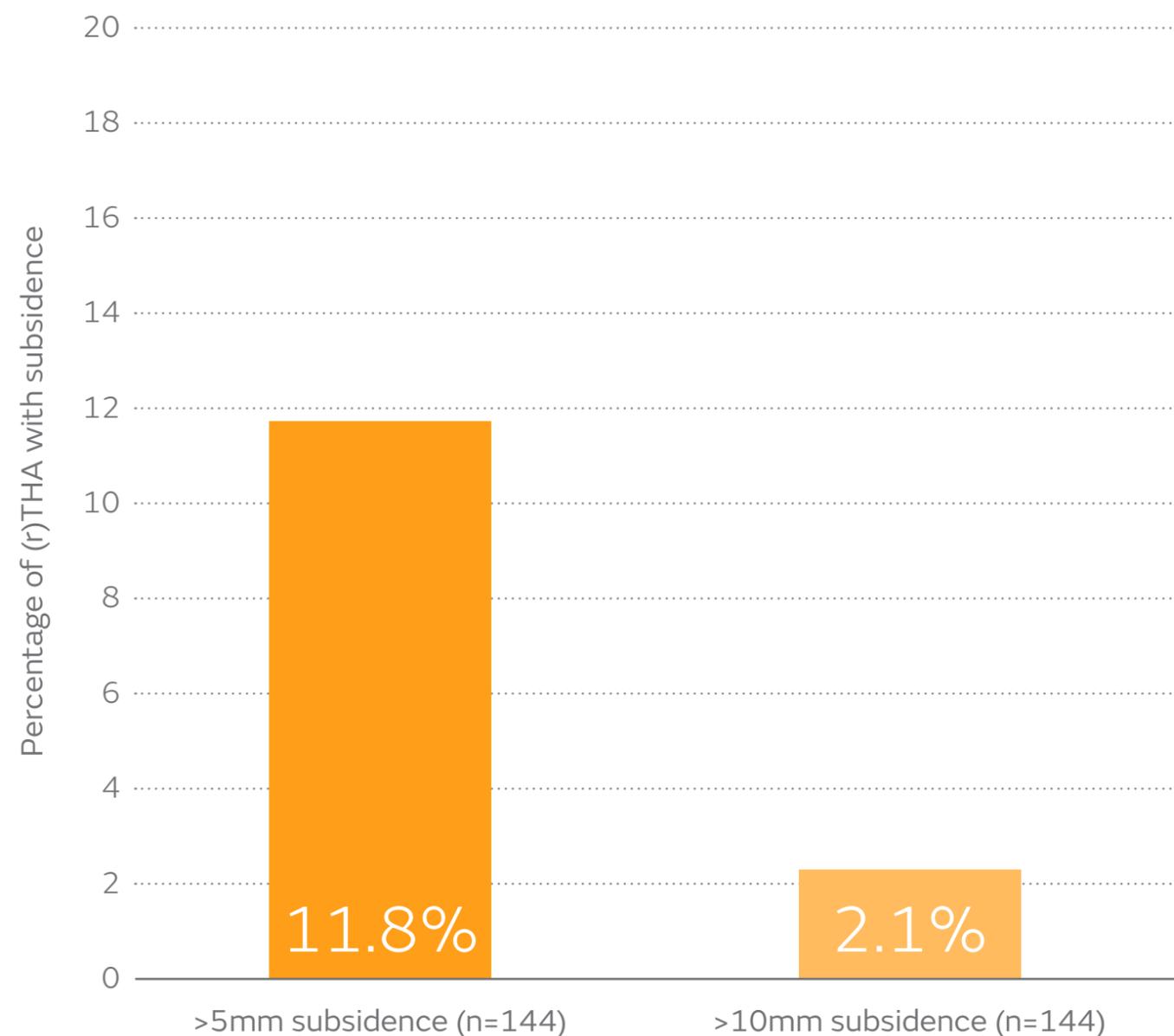


REDAPT[◇] Revision Femoral Stem: 1-year results from a multicentre, retrospective study^{10*}

- Mean total subsidence at latest follow-up was 1.64mm and was minimal beyond 3 months
- Stem subsidence >5mm and >10mm was 11.8% (17/144) and 2.1% (3/144) respectively
- No revisions due to subsidence[†]
- All patients achieved stable fixation on last follow-up evaluation

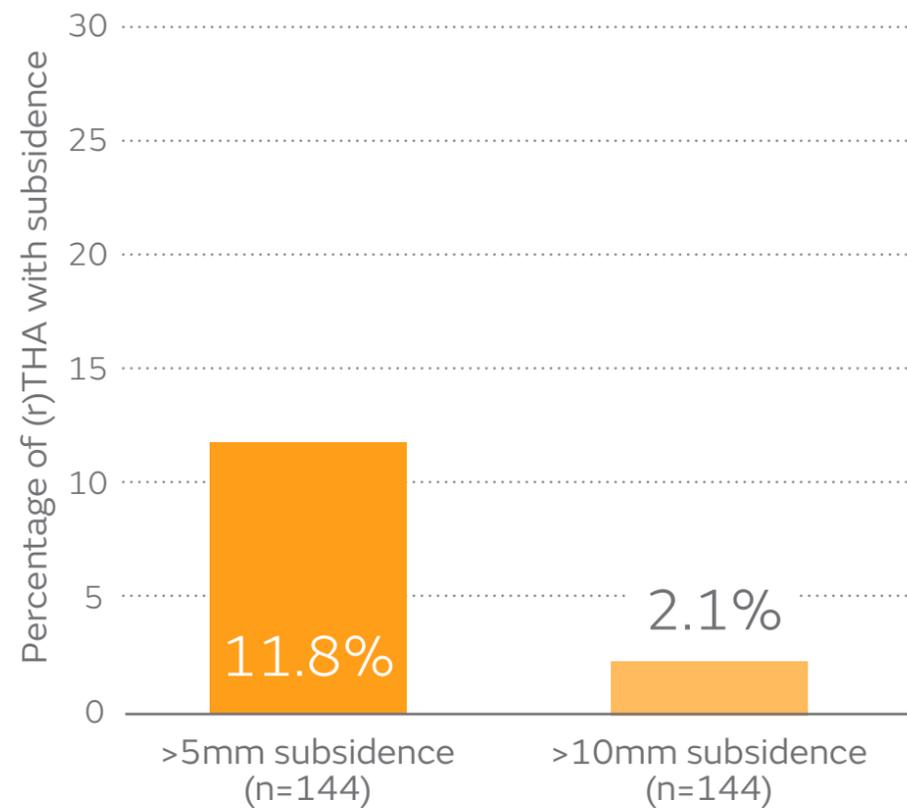
*157 (r)THAs using REDAPT Revision Femoral Stems in 153 patients; surgeries performed by 10 fellowship-trained surgeons at 4 US centres. [†]Six re-revisions (3.7%): one stem revision, due to infection.

REDAPT Revision Femoral Stem subsidence rate

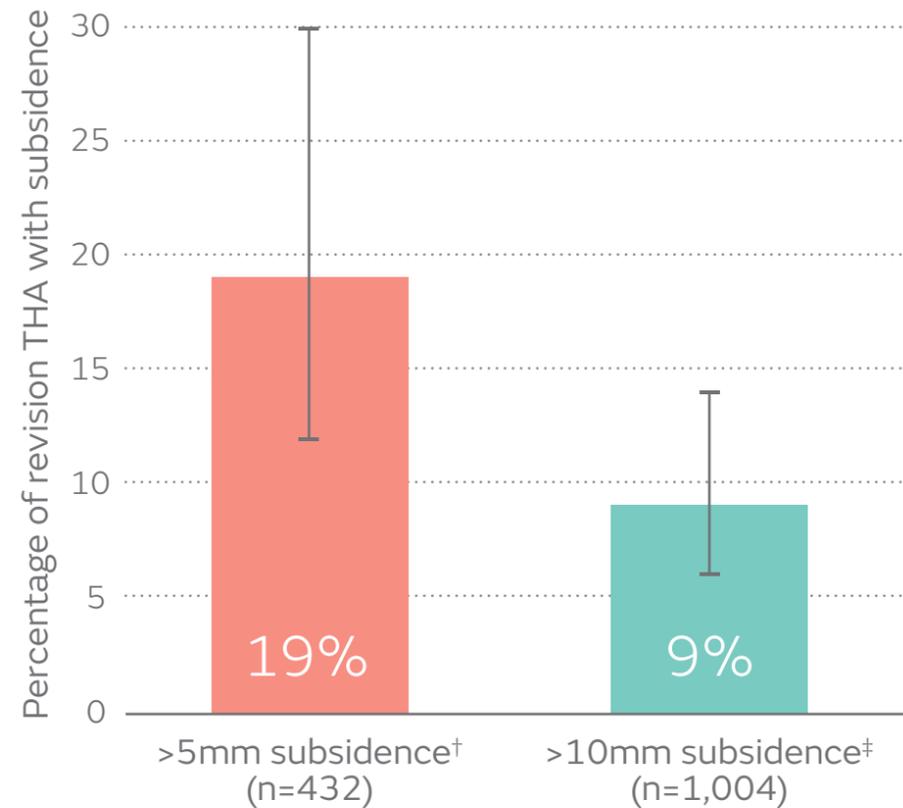


REDAPT[◇] Revision Femoral Stem may result in lower subsidence rates than Wagner SL Revision[™] Stem

REDAPT Revision Femoral Stem
subsidence rate: results
of a single study^{10*}



Wagner SL Revision Stem
subsidence rate (95% CI): results of a systematic
literature review and meta-analysis⁹



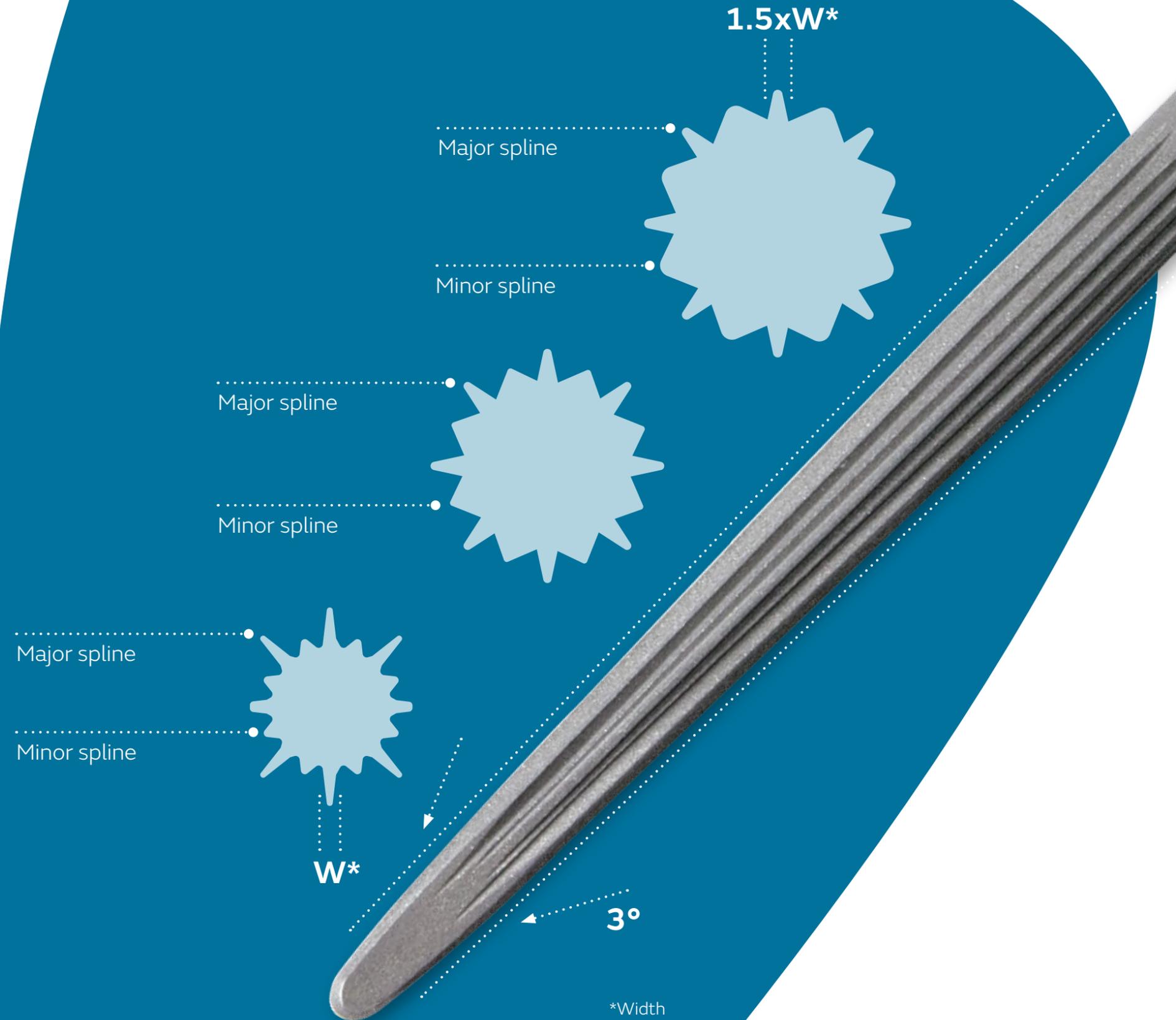
*A multicentre, retrospective study of 157 (r)THAs using REDAPT Revision Femoral Stems (mean follow-up: 11.6 months).

[†]Number of studies, 8 (mean follow-up: 2.1–13.9 years). [‡]Number of studies, 16 (mean follow-up: 2.0–15.7 years).



REDAPT[◇] Revision Femoral Stem patented ROCKTITE[◇] Flutes are designed to deliver reliable stability

- *In vitro* and *in vivo* studies have demonstrated that ROCKTITE fixation renders REDAPT Revision Femoral Stem resistant to subsidence^{11,12}
- 3° taper angle with ROCKTITE fixation¹³
- Proprietary multi-level spline pattern designed for subsidence control and axial and rotational stability¹³



Summary

REDAPT[◇] Revision Femoral Stem may result in lower rates of subsidence compared to Wagner SL Revision™ Stem. Approximately 88% of rTHA patients experienced subsidence <5mm with REDAPT Revision Femoral Stem; 2% experienced subsidence >10mm at 1 year; none required revision due to subsidence.¹⁰

By reducing subsidence rates, REDAPT Revision Femoral Stem may help to reduce the re-revision rate of rTHAs and the human and economic burden of rTHAs.



Click on the links to find out more about REDAPT[®] Revision Hip System

Evidence in focus
Publication summary: Gabor JA, et al. *Bone Joint J* (2020)²⁰

REDAPT[®] Revision Femoral System demonstrates stable fixation and subsidence <math>< 1\text{mm}</math> within the first year post-surgery in 98% of hips

Plus points

- Subsidence <math>< 1\text{mm}</math> in 98% of hips
- REDAPT stem subsidence minimal (less than 1mm) at 12 months
- No stem revisions

Overview

- A multicentre, retrospective study investigating short-term subsidence in 120 consecutive patients receiving REDAPT[®] Revision Femoral System
- 120 revision total hip arthroplasties (rTHA)
- 13 complete primary THAs
- 13 conversion arthroplasties
- Surgery performed by 10 fellowship-trained surgeons at four US centres
- Outcomes included intraoperative complications, hip revision and subsidence
- Mean follow-up: 12.6 months

Results

- 10% intraoperative complications (5.1%)
- Six re-revisions (3.7%)
- One stem revision due to infection
- No stem revision for aseptic loosening
- Mean total subsidence at latest follow-up was 1.64mm and was minimal (less than 1mm) in 98%
- Stem subsidence <math>< 1\text{mm}</math> was 13.8% (17/124) and 3.1% (4/124), respectively (Figure)
- Stem subsidence <math>< 1\text{mm}</math> was due to underdrilling in all cases

Conclusions

REDAPT[®] Revision Femoral System was associated with stable fixation within one year of hip surgery. Stem subsidence <math>< 1\text{mm}</math> and <math>< 0.5\text{mm}</math> were reported within the first year following surgery.

Citation

Gabor JA, Phillips JA, Peng JL, Schwann L, Lukes WS, Rank AJ, Inzana S, Vigliani J, Schwann J, Schwann J. Short-term outcomes with the REDAPT[®] monolithic, tapered, fluted, grit-blasted, forged titanium revision femoral stem. *Bone Joint J* 2020;102-B(10):191-197. Available at: [The Bone and Joint Journal](https://doi.org/10.1302/0301-6203.102B10191)

Short-term outcomes with a monolithic, tapered, fluted, grit-blasted, forged titanium revision femoral stem

Gabor JA, et al. *Bone Joint J* (2020)

Evidence in focus
Publication summary: Clair AJ, et al. *J Arthroplasty* (2020)²¹

REDAPT[®] Revision Femoral System decreases the incidence of subsidence compared to modular stems in revision total hip arthroplasty (rTHA)

Plus points

- Significantly lower subsidence compared to modular stems
- 61% Relative reduction in subsidence with REDAPT stems versus modular stems
- REDAPT stems achieve lower levels of subsidence irrespective of Porsyony classification of femoral neck defects compared to modular stems

Overview

- Retrospective, observational study comparing rates of subsidence <math>< 1\text{mm}</math> versus non-modular tapered, fluted, grit-blasted (TF) stems
- Non-modular stems included REDAPT[®] Revision Femoral System, Modular stems, or 304 Revision Modular System (Kalamazoo, MI, USA; Zimmer Biomet, Warsaw, IN, USA)
- Surgery performed by 17 orthopaedic surgeons at a single US centre
- Retrospective follow-up: 3 months to 3 years (mean, 1.4 months)

Results

- Average subsidence was significantly higher with modular stems compared to REDAPT stems (3.9 vs 2.2 mm, $p < 0.001$)
- Significantly greater proportion of modular stems underwent <math>< 1\text{mm}</math> subsidence at latest radiographic follow-up compared to REDAPT stems (29.3 vs 11.3%, $p < 0.001$) (Figure)
- REDAPT stems had a significantly lower rate of subsidence in low-grade femoral defects (0.8 vs 2.5%, $p < 0.001$) and high-grade femoral defects (2.4 vs 3.8%, $p < 0.012$) compared to modular stems

Conclusions

REDAPT[®] Revision Femoral System reduces the incidence of post-operative subsidence and lower stem energy, which is associated with greater durability, across a variety of neck types. The authors note that the modular hip for the REDAPT[®] stem has the same length, ability to correct the starting length, offset, and neck offset as the modular stem.

Citation

Clair AJ, Gabor JA, Patel H, Friedlander S, Deshmukh AJ, Schwann J. Subsidence following revision total hip arthroplasty using modular and non-modular components. *J Arthroplasty* 2020;35:2299-2302. Available from: [Journal of Arthroplasty](https://doi.org/10.1054/j.1528-7465.2020.102811.x)

Subsidence following revision total hip arthroplasty using modular and monolithic components

Clair AJ, et al. *J Arthroplasty* (2020)

Evidence in focus
Publication summary: Clair AJ, et al. *J Arthroplasty* (2019)²²

Nonmodular stems demonstrate similar clinical outcomes to modular stems in revision total hip arthroplasty (rTHA) and may provide improved value

Safety outcomes were similar with both types of stem

Study overview

- Single-centre, retrospective review of all rTHA using modular or nonmodular revision implants between 1 January 2013 and 30 September 2017 with a minimum 3-month follow-up
- 146 rTHAs met the inclusion criteria
- Non-modular: 43
- Modular: 103
- Porsyony classification of bone loss, surgical details and clinical outcomes (revision and reoperation rates and post-operative complications) were analysed

Key results

- Nonmodular stems were used for a larger percentage of Type IIA and III Porsyony defects compared to the modular group (Figure)
- No statistically significant difference was observed in complication rates between modular and nonmodular femoral implant groups (Table)
- In this centre, modular femoral implants were associated with a significantly higher cost than nonmodular femoral implants (320.8% higher, $p < 0.001$)

	Nonmodular (n=43)	Modular (n=103)	p-value
Type I	1 (2.3%)	1 (1.0%)	0.75
Type II	1 (2.3%)	1 (1.0%)	0.75
Type III	1 (2.3%)	1 (1.0%)	0.75
Type IIA	1 (2.3%)	1 (1.0%)	0.75
Type IIB	1 (2.3%)	1 (1.0%)	0.75
Type IIC	1 (2.3%)	1 (1.0%)	0.75
Type IIIA	1 (2.3%)	1 (1.0%)	0.75
Type IIIB	1 (2.3%)	1 (1.0%)	0.75
Type IIIC	1 (2.3%)	1 (1.0%)	0.75
Type IIIIA	1 (2.3%)	1 (1.0%)	0.75
Type IIIIB	1 (2.3%)	1 (1.0%)	0.75
Type IIIIC	1 (2.3%)	1 (1.0%)	0.75
Type IIIIA	1 (2.3%)	1 (1.0%)	0.75
Type IIIIB	1 (2.3%)	1 (1.0%)	0.75
Type IIIIC	1 (2.3%)	1 (1.0%)	0.75

Conclusion

Despite greater use in patients with high-grade Porsyony defects, nonmodular femoral implants demonstrated similar clinical outcomes to modular femoral implants, and were associated with a lower cost. Use of nonmodular femoral implants in rTHA may provide improved value, compared to using modular femoral implants, without compromising safety and quality.

Study citation

Clair AJ, Gabor JA, Inzana S, et al. Nonmodular stems are a viable alternative to modular stems in revision total hip arthroplasty. *J Arthroplasty* 2019;34:18-24. Available at: [Journal of Arthroplasty](https://doi.org/10.1054/j.1528-7465.2019.102811.x)

Nonmodular stems are a viable alternative to modular stems in revision total hip arthroplasty

Clair AJ, et al. *J Arthroplasty* (2019)

Evidence in focus
Meeting highlights
Hip Revision Masterclass, 9-10 May 2019, Berlin, Germany

Using the REDAPT[®] Revision Hip System to help achieve the goals of revision surgery

The Hip Revision Masterclass was held 9-10 May 2019 in Berlin, Germany, with a panel of international expert faculty presenting practical guidance to overcome the challenges of medical and surgical management of revision hip surgery. The summary highlights the goals and challenges of femoral and acetabular revision surgery, and solutions based on the clinical experience of several speakers.

Goals of revision surgery

- Stability: avoid re-revision by achieving stable bony fixation of acetabular and femoral components
- Adaptability and reproducibility: identify processes, tools and implants that enable reliable outcomes regardless of case complexity

Challenges

- Difficult indications for revision (e.g. infection and dislocation)
- Good positioning of cup and stem, particularly in large defects, for strong fixation and stability with preserving bone stock
- Working with existing bone stock and existing subsidence
- Precautions during surgery to adjust the planned approach and deal with unpredictable instability

Key discussion points

Stability: stem and cup

During the presentation entitled 'Modular or non-modular stems for revision THA', Dr Ben Schwann from the University College London, London, UK, described the goals of revision arthroplasty are the same for primary surgery, to achieve adequate leg length, stable fixation and restore biomechanics. He explained that non-modular stems such as the REDAPT[®] Revision Femoral Stem meet these goals, achieving early, reliable and reproducible fixation, which aids early patient mobilisation, while preserving bone as goals.

Adaptability and reproducibility: stem

In his presentation 'Key clinical experience with a new ceramicless revision stem', Dr Sush Kohan from the University of California, San Diego, CA, explained that the goals of revision arthroplasty are the same for primary surgery, to achieve adequate leg length, stable fixation and restore biomechanics. He explained that non-modular stems such as the REDAPT[®] Revision Femoral Stem meet these goals, achieving early, reliable and reproducible fixation, which aids early patient mobilisation, while preserving bone as goals.

Practical guidance for femoral revision

- To avoid intra-operative femoral fracture during femoral stem insertion, apply consistent and gentle 'bump' forces, obtain the intended position of fixation, determine progression as a team with the help of a fluoroscopy, and know when to stop.
- Psychologic: visual intra-cannal saw made effective at preventing femoral neck propagation than power/turns cables.
- Understand stems lead to subsidence: to determine the optimal cup, measure and decide on the zone of cancellous bone pre-operatively, and continue to assess during surgery with measurements, X-ray evidence and feel.

Focus on REDAPT[®] Revision Hip System

Hip Revision Masterclass. May 9-10, 2019; Berlin, Germany.

Appendix: systematic literature review and meta-analysis studies*

Citation	>5mm subsidence	>10mm subsidence
Baktir A, Karaaslan F, Gencer K, Karaoglu S. Femoral revision using the Wagner SL revision stem: A single-surgeon experience featuring 11–19 years of follow-up. <i>J Arthroplasty</i> . 2015;30(5):827–834.		✓
Bohm P, Bischel O. [Cement-free diaphyseal fixation principle for hip shaft exchange in large bone defects – analysis of 12 years experience with the Wagner revision shaft]. <i>Z Orthop Ihre Grenzgeb</i> . 2001;139(3):229–239.	✓	✓
Gutierrez Del Alam Gutierrez Del Alamo J, Garcia-Cimbrello E, Castellanos V, Gil-Garay E. Radiographic bone regeneration and clinical outcome with the Wagner SL revision stem: a 5-year to 12-year follow-up study. <i>J Arthroplasty</i> . 2007;22(4):515–524.		✓
Hellman MD, Kearns SM, Bohl DD, Haughom BD, Levine BR. Revision total hip arthroplasty with a monoblock splined tapered grit-blasted titanium stem. <i>J Arthroplasty</i> . 2017;32(12):3698–3703.		✓
Huang Y, Zhou Y, Shao H, Gu J, Tang H, Tang Q. What is the difference between modular and nonmodular tapered fluted titanium stems in revision total hip arthroplasty. <i>J Arthroplasty</i> . 2017;32(10):3108–3113.	✓	✓
Isacson J, Stark A, Wallensten R. The Wagner revision prosthesis consistently restores femoral bone structure. <i>Int Orthop</i> . 2000;24(3):139–142.	✓	✓
Ko PS, Lam JJ, Tio MK, Lee OB, Ip FK. Distal fixation with Wagner revision stem in treating Vancouver type B2 periprosthetic femur fractures in geriatric patients. <i>J Arthroplasty</i> . 2003;18(4):446–452.	✓	✓
Lyu SR. Use of Wagner cementless self-locking stems for massive bone loss in hip arthroplasty. <i>J Orthop Surg (Hong Kong)</i> . 2003;11(1):43–47.	✓	✓
Mantelos G, Koulouvaris P, Kotsovolos H, Xenakis T. Consistent new bone formation in 95 revisions: average 9-year follow-up. <i>Orthopedics</i> . 2008;31(7):654.		✓
Negri S, Regis D, Sandri A, Bonetti I, Magnan B. Long-term outcome of the Wagner SL tapered stem in complex revisions. <i>HIP International</i> . 2018;28:70–71.	✓	
Regis D, Sandri A, Bartolozzi P. Stem modularity alone is not effective in reducing dislocation rate in hip revision surgery. <i>J Orthop Traumatol</i> . 2009;10(4):167–171.		✓
Regis D, Sandri A, Bonetti I, Braggion M, Bartolozzi P. Femoral revision with the Wagner tapered stem: a ten- to 15-year follow-up study. <i>J Bone Joint Surg Br</i> . 2011;93(10):1320–1326.	✓	✓
Sandiford NA, Garbuz DS, Masri BA, Duncan CP. Nonmodular tapered fluted titanium stems osseointegrate reliably at short term in revision THAs. <i>Clin Orthop Relat Res</i> . 2017;475(1):186–192.		✓
Singh SP, Bhalodiya HP. Results of Wagner SL revision stem with impaction bone grafting in revision total hip arthroplasty. <i>Indian J Orthop</i> . 2013;47(4):357–363.		✓
Weber M, Hempfing A, Orlor R, Ganz R. Femoral revision using the Wagner stem: results at 2–9 years. <i>Int Orthop</i> . 2002;26(1):36–39.	✓	✓
Zang J, Uchiyama K, Moriya M, Fukushima K, Takahira N, Takaso M. Long-term outcomes of Wagner self-locking stem with bone allograft for Paprosky type II and III bone defects in revision total hip arthroplasty: A mean 15.7-year follow-up. <i>J Orthop Surg</i> . 2019;27(2); https://doi.org/10.1177/2309499019854156		✓
Zeng M, Xie J, Li M, Lin S, Hu Y. Cementless femoral revision in patients with a previous cemented prosthesis. <i>Int Orthop</i> . 2015;39(8):1513–1518.	✓	✓

*Most studies did not specify the generation of Wagner SL used.

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1. Badarudeen S, Shu AC, Ong KL, et al. Complications after revision total hip arthroplasty in the Medicare population. *J Arthroplasty*. 2017;32:1954–1958. **2.** Sloan M, Sheth N. Projected volume of primary and revision total joint arthroplasty in the United States, 2030–2060. Oral presentation at American Academy of Orthopaedic Surgeons; March 6–10, 2018; New Orleans, LA. **3.** Gwam CU, Mistry JB, Mohamed NS, et al. Current epidemiology of revision total hip arthroplasty in the United States: National Inpatient Sample 2009 to 2013. *J Arthroplasty*. 2017;32:2088–2092. **4.** Evans JT, Evans JP, Walker RW, et al. How long does a hip replacement last? A systematic review and meta-analysis of case series and national registry reports with more than 15 years of follow-up. *Lancet* 2019;393:647–654. **5.** Weber M, Renkawitz T, Voellner F, et al. Revision surgery in total joint replacement is cost-intensive. *Biomed Res Int*. 2018;2018:8987104. **6.** Kenney C, Dick S, Lea J, et al. A systematic review of the causes of failure of revision total hip arthroplasty. *Journal of Orthopaedics*. 2019;16:393–395. **7.** Girard J, Roche O, Wavreille G, et al. Stem subsidence after total hip revision: 183 cases at 5.9 years follow-up. *Orthop Traumatol Surg Res*. 2011;97:121–126. **8.** Tangsataporn S, Safir OA, Vincent AD, et al. Risk factors for subsidence of a modular tapered femoral stem used for revision total hip arthroplasty. *J Arthroplasty*. 2015;30:1030–1034. **9.** Roussi K. Determination of subsidence rates of Wagner SL in revision total hip arthroplasty. Smith & Nephew internal report: EO/RECON/REDAPT/004/v1. 2019. **10.** Gabor JA, Padilla JA, Feng JE, et al. Short-term outcomes with the REDAPT monolithic, tapered, fluted, grit-blasted, forged titanium revision femoral stem. *Bone Joint J*. 2020;102-B(2):191–197. **11.** Smith & Nephew 2008. Orthopaedic Research Report - OR-08-168. **12.** Ngu AWT, Rowan FE, Carli AV, et al. Single 3° tapered fluted femoral stems demonstrate low subsidence at mid-term follow-up in severe bony deficiency. *Ann Transl Med*. 2019;7:725–731. **13.** Smith & Nephew: REDAPT design rationale 7138-1686 REV0 01/13. Available from: https://www.smith-nephew.com/global/assets/pdf/products/surgical/redapt_design_rationale_71381686.pdf Last accessed 12 May 2020.