

ANGULATED SCREW CHANNEL (ASC) SOLUTION FOR INCREASED PRELOAD

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Images courtesy of Southern Implants

❖ Due to the angle at which the screw tightening torque is applied:

- The maximum achievable tightening torque is reduced to prevent interface distortion.
- Torque transfer decreases as angulation increases.
- There is limited interface engagement.
- This leads to a decreased preload in the retaining screw.
- Causing ASC Solutions to gain a reputation of being associated with “screw loosening”.

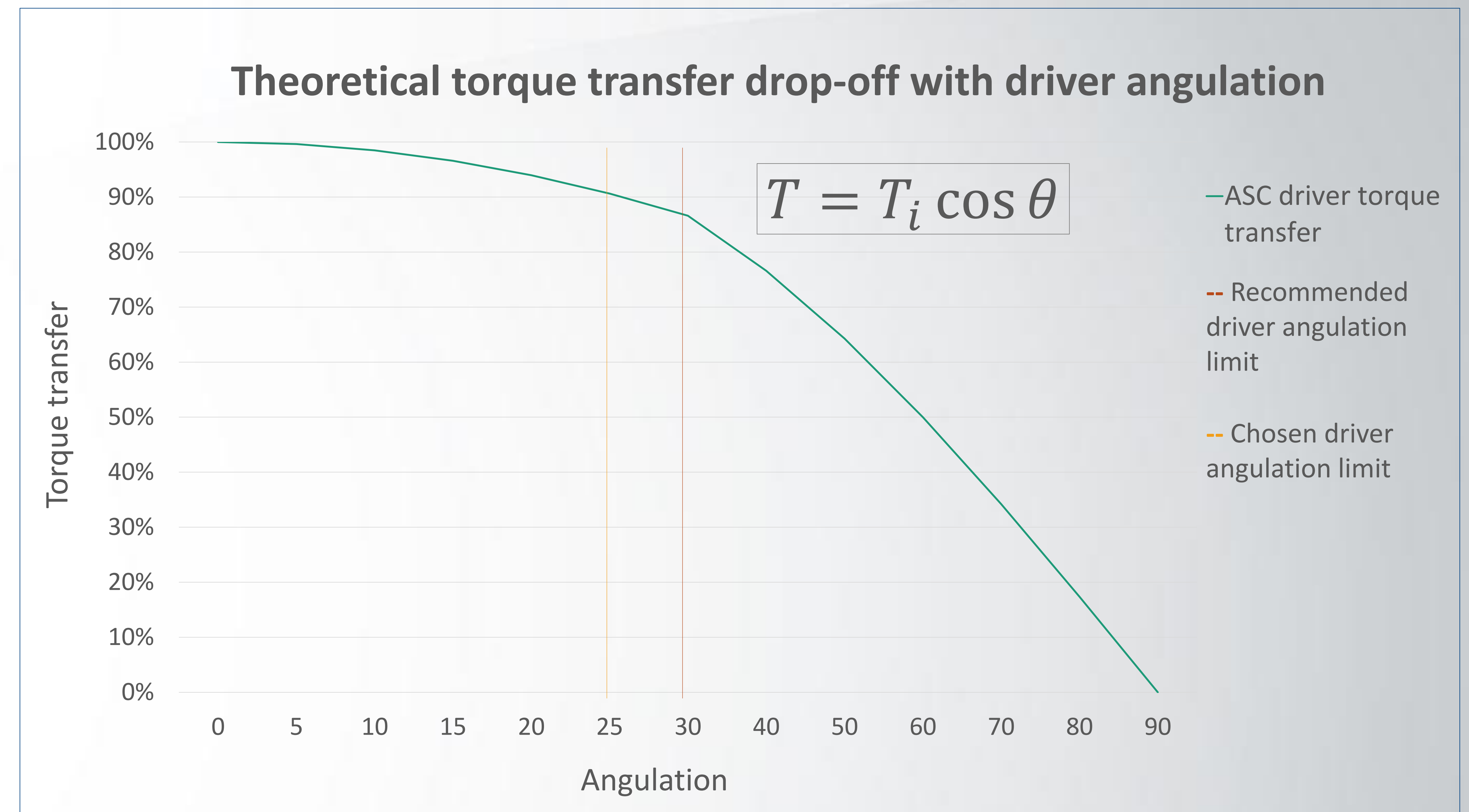
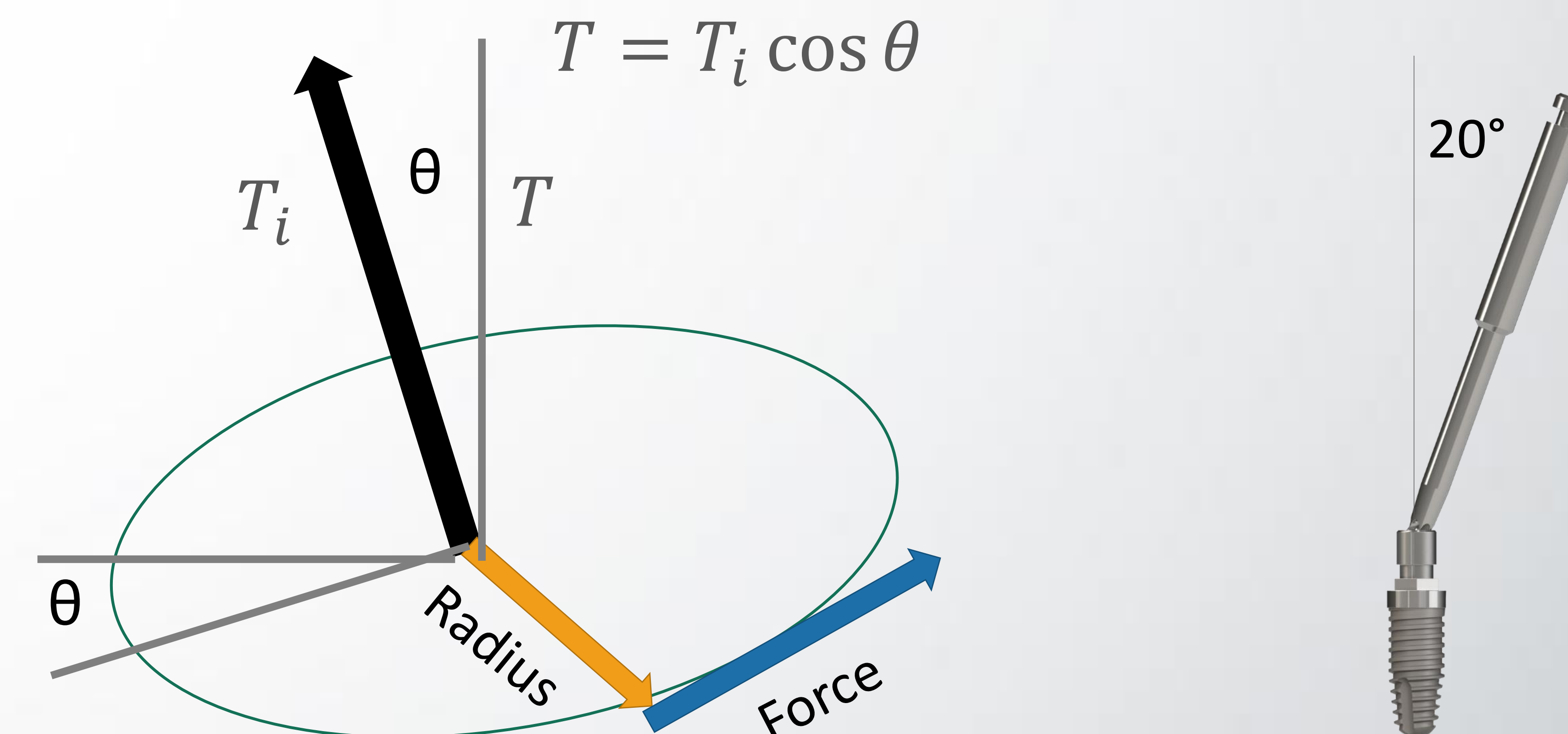
❖ Pilot study using two-piece zirconia abutments with metallic bases, an angulation of 25° and tightening torque of 35 N.cm observed that 80% of ASC and zirconia crowns failed catastrophically due to abutment fractures¹.

❖ An **optimally designed ASC solution** will lend to achieving higher tightening torque resulting in higher preload, higher fracture strength and therefore lowering the risk of screw loosening.

❖ **Optimally designed solution:**

- Material choice and strength of material
- Connection interface
- Dimensions of solution components

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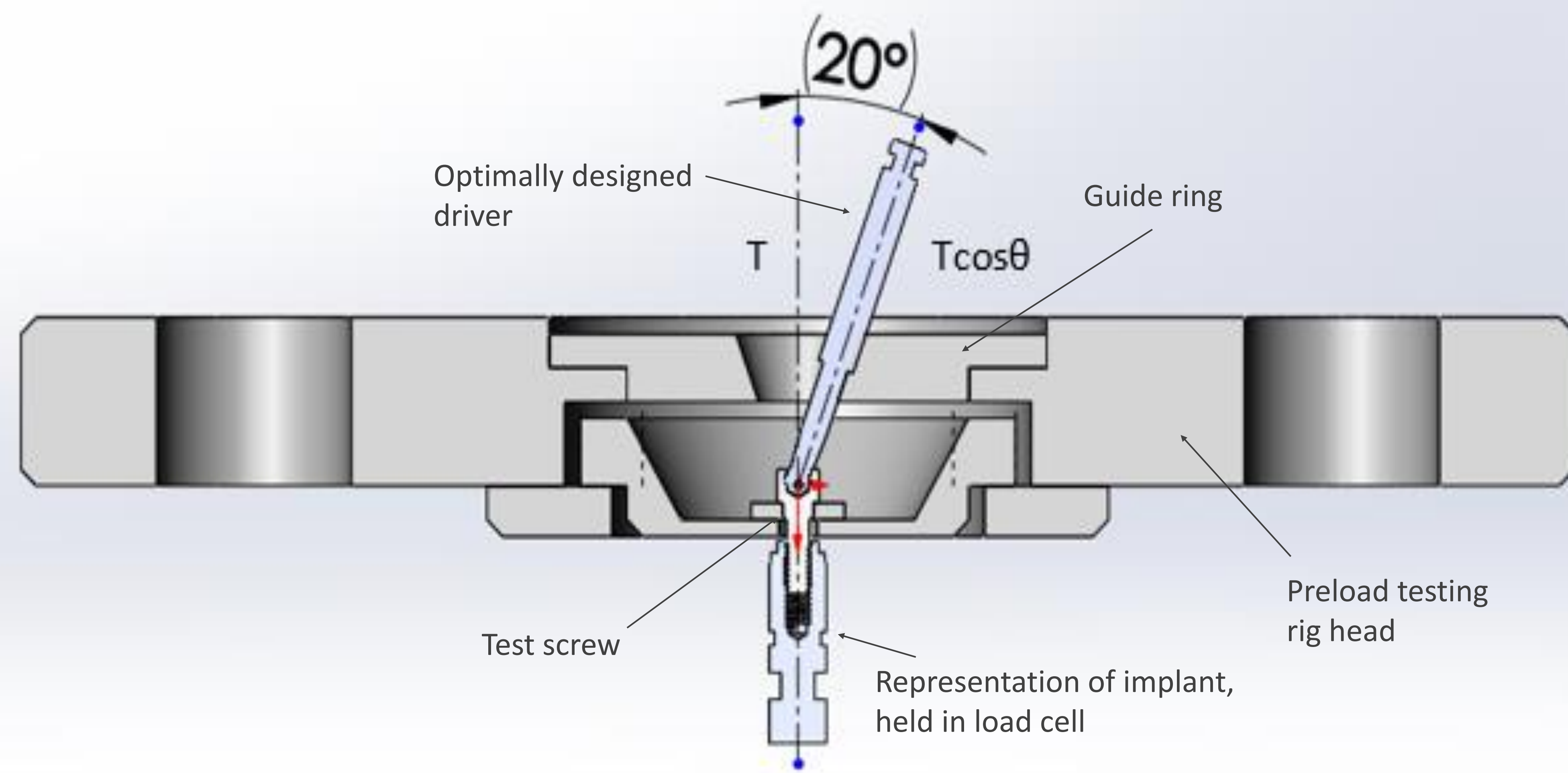


¹Drew A, Randi A, DiPede L, Luke A. Fracture strength of implant screw-retained all-ceramic crowns with the use of the Angulated Screw Channel: A pilot study. The International Journal of Periodontics & Restorative Dentistry. 2018 Aug 18; 40(2):245-252.

AIM: to propose a new ASC Solution, which can take up to 45 N.cm torque and generate preload equivalent to or greater than that generated by non-angulated solutions (0°) within the recommended torque range (32 – 40 N.cm)

METHOD:

- ❖ Preload measurements were recorded in Titanium M2 test screws.
- ❖ Application torques ranging from 30-45 N.cm (5N.cm increments).
- ❖ At each input torque, **optimally designed driver** was angulated relative to the screw axis at set positions between 0-25°, using custom designed guide rings.
- ❖ Preload measurements were repeated 5 times with new screws at each angulation condition.



Cross section of guide ring setup to ensure driver is maintained at 20° during preload measurement for 20° Angulation case, M2 Titanium screw

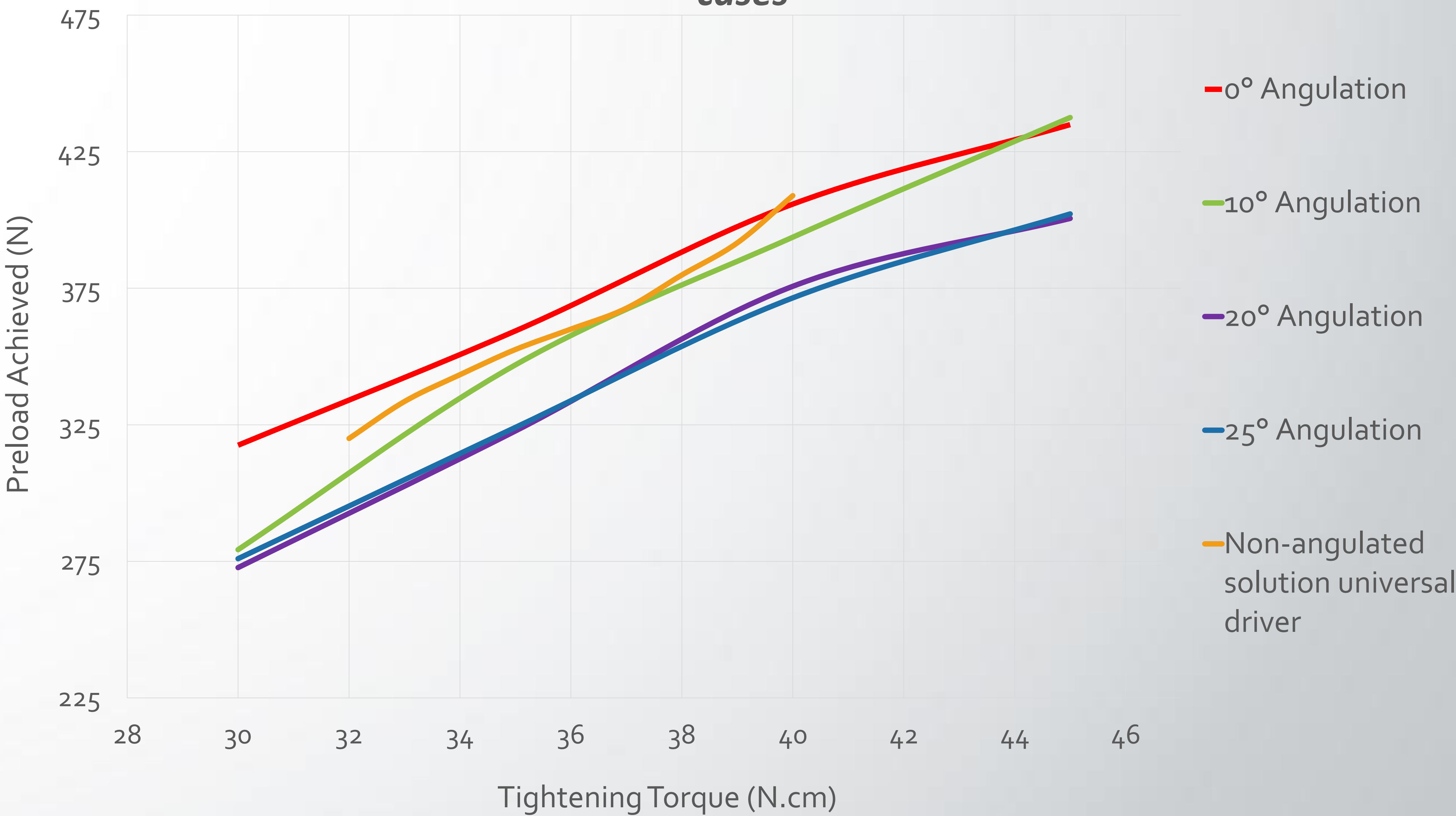
RESULTS

- ❖ Larger reduction in developed preload at lower tightening torques – (30 N.cm) for all angulation conditions.
- ❖ 10° Angulation – 0-3 % drop in developed preload (35 – 45 N.cm).
- ❖ 20 & 25° Angulation – 7-10% drop in developed preload (35 – 45 N.cm).
- ❖ A larger tightening torque achieved a higher preload.
- ❖ 45 N.cm achieved at all angulations without interface distortion.
- ❖ Preload achieved at 45 N.cm for 10°, 20° and 25° angulation conditions is 1.0 to 1.3 times greater than preloads achieved within the recommended torque range (32 - 40 N.cm) for the 0° angulation condition.
- ❖ For the 0° and 10° angulation conditions for the proposed ASC Solution, the achieved preload is equal to or greater than the preload achieved using a straight universal driver, which is the current non-angulated solution.
- ❖ For the 20° and 25° angulation conditions for the proposed ASC Solution, the achieved preload sees a ≤ 10% reduction compared to the preload achieved using the straight universal driver.

Observed reduction in developed preload across angulation cases at various tightening torques compared to the 0° angulation case

Tightening Torque (N.cm)	Reduction in developed preload		
	10°	20°	25°
30	12%	14%	13%
35	3%	10%	10%
40	3%	7%	8%
45	0%	8%	8%

Averaged Preload results obtained for 0°, 10°, 20° and 25° driver angulation cases



CONCLUSIONS

- ❖ For angulation conditions up to 10° , $\leq 3\%$ decrease in preload is observed when compared to the 0° angulation condition.
- ❖ For angulation conditions from 10° up to 25° , $\leq 10\%$ decrease in preload is observed when compared to the 0° angulation condition.
- ❖ For all angulation conditions, the optimally designed ASC solution achieves preload **1.0 – 1.3 times greater at 45 N.cm** than the preload achieved within the recommended torque range (32 - 40 N.cm) for the 0° angulation condition.
- ❖ An **optimally designed ASC Solution** has been developed for increased preload, with the following features:

OPTIMALLY DESIGNED ANGULATED SCREW CHANNEL SOLUTION

❖ High strength metal materials for all components:

- Titanium grade 4 and 5, hardened and passivated stainless steel.
- Preload influenced by friction coefficient between screw and abutment screw seat.
- Lowers risk of interface distortion and driver breaking from application of high torques.
- Allows for higher tightening torques and improves interface engagement.

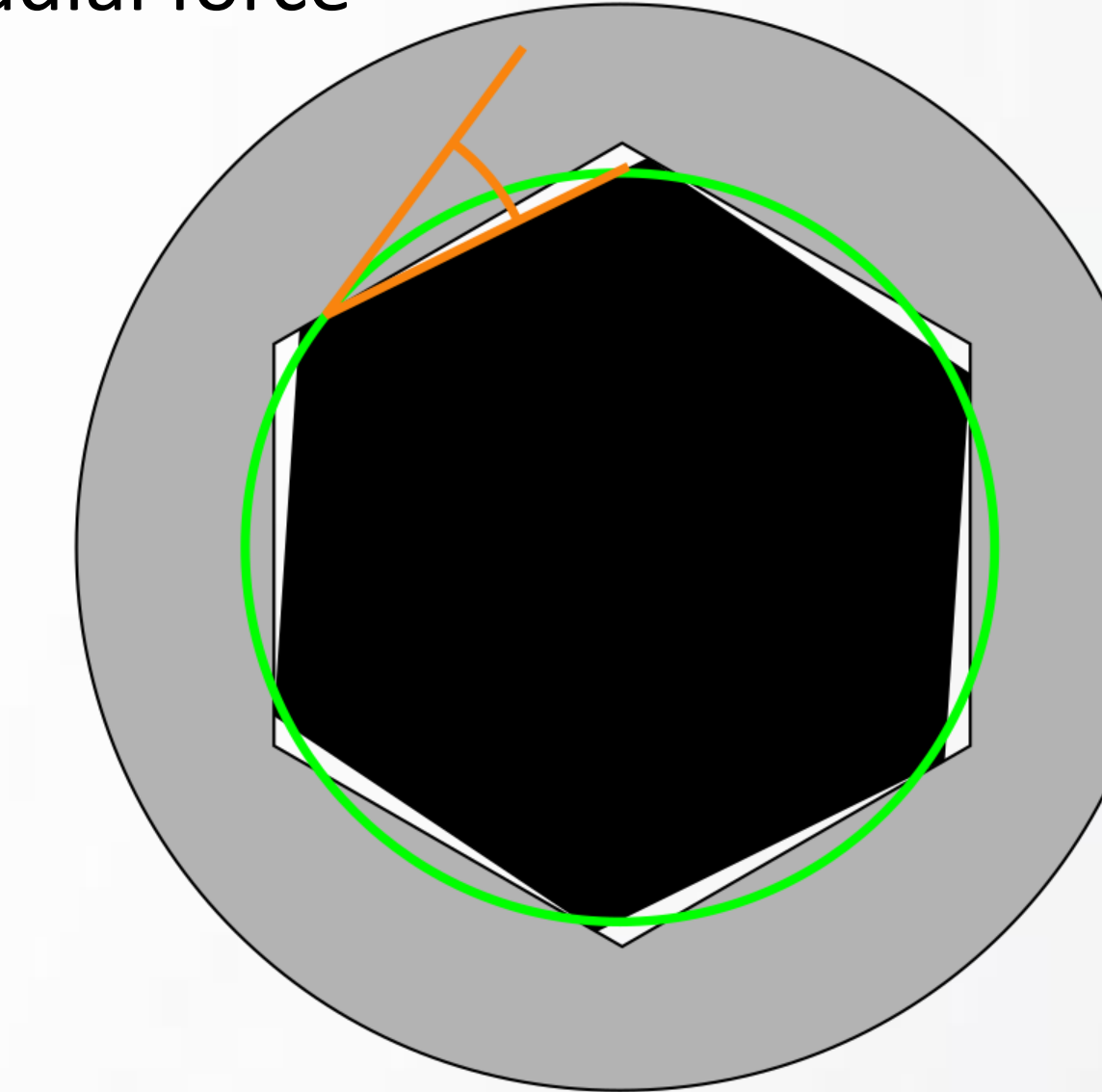
❖ Connection interface which lowers radial force:

- Lower radial force at specified torque reduces risk of stripping screw interface.
- Higher tightening torque can be achieved.
- Better interface engagement when radial forces are lower.

❖ Optimal dimensions of all components:

- Improved interface engagement between driver and screw.
- Screw head diameter important to support interface connection and desired tightening torque.
- Driver connection interface dimensions important to achieve desired angulation and to avoid stripping of screw or driver interface.

Higher radial force



Lower radial force

