SITA SWAP™

Frequently Asked Questions

Why do I need SITA SWAP?

As described in the document below, SITA SWAP helps doctors detect glaucoma earlier than standard white-on-white perimetry.

With earlier detection, doctors can start necessary glaucoma management and/or treatment earlier, potentially reducing visual field loss.

Which patients benefit most?

SITA SWAP is particularly appropriate for managing glaucoma suspects, especially younger patients.

For which instruments is it available?

HFA 745, 750, 745i, & 750i

What are the features of SITA SWAP?

- Early detection of visual field loss with SWAP technology
- SWAP testing in about 3 - 6 minutes per eye
- Greater dynamic (brightness) range than previous SWAP tests
- Less variability (narrower normal range) than previous SWAP tests
- All at the same degree of reproducibility as previous SWAP tests

How is SITA SWAP related to Short Wavelength Automated Perimetry (SWAP)?

SITA applied to SWAP makes SWAP testing a practical reality. However, the basic technology to get earlier detection of visual field loss, SWAP, is the same. Please see the description below for additional information.

SWAP (blue-on-yellow technology)

SWAP differs from standard automated static perimetry only in that a carefully chosen wavelength of blue light is used as the stimulus, and a specific color and brightness of yellow light is used for the background illumination. Except for these differences, blue-yellow perimetry is still a basic threshold perimetry test, in which standard Goldmann stimuli are presented in the conventional way.

In longitudinal studies, blue-yellow perimetry performed much better than standard perimetry in identifying early glaucomatous changes. SWAP has also been found useful in detecting damage from neuro-ophthalmic conditions, diabetes, and age-related macular degeneration.

How does SWAP work?

SWAP isolates and measures blue-yellow cone function. The carefully chosen bright yellow background desensitizes the green and red cones, and has little effect an blue cone function. Further, the narrow band 440 nanometer blue stimulus falls right an the peak sensitivity of blue cones. Thus, SWAP tests the blue cones and their ganglion cell connections.

There are at least two theories that explain why SWAP testing provides earlier diagnosis:

One theory („Targeting early damage“) suggests that the ganglion cells associated with the cone function are selectively damaged in early glaucoma, and thus earlier diagnosis is simply a function of testing the part of the visual system that is damaged first.

A second theory („Reduced redundancy“) suggests that early diagnosis is achieved simply because SWAP tests only one of several pathways of the visual system. As a result, damage detected when targeting this single pathway is less likely masked by other pathways, allowing loss to be discovered earlier.

Carl Zeiss Meditec has other perimetry technologies for the early detection of glaucoma (Humphrey® FDT™ & Matrix™). How are these technologies different from SITA SWAP?

Both SWAP and FDT/Matrix have been found to detect glaucomatous loss earlier than white-on-white perimetry. However, the type of stimulus used in the FDT and Matrix is believed to test a different visual pathway than SWAP, and as such, may detect different damage than SWAP.

The needs of your patient base and practice should be evaluated when considering which technology is more appropriate for your practice.

SITA SWAP is software that can be uploaded onto existing 745, 745i, 750, and 750i units, making early glaucoma detection an an existing gold standard device a practical reality.

Frequency Doubling Technology is provided an a separate instrument. These instruments are small in size, easy to use, have rapid test times, and offer a good value to doctors looking for an alternative or complement to the HFA.

Many offices have both technologies, either for improving workflow efficiency or for providing an additional source of diagnostic information.

How well does SWAP correlate with structural RNFL exams?

SWAP has been shown to correlate with the earlier glaucoma damage detected with RNFL imaging.

The need to evaluate both structure and function in the diagnosis and management of glaucoma has been established by the Association of International Glaucoma Societies. In their 2003 Consensus Statements an Structure and Function, they state,

> „In different cases, either structural examination or functional testing may provide more definitive evidence of glaucoma, so both are needed for detection and confirmation of the subtle early stages of the disease.“

What test patterns are available?

SITA SWAP testing is available an the 24-2 test pattern. The doctor must select a 24-2 threshold test to turn on SITA SWAP.

Carl Zeiss Meditec recommends using the ALTER MAIN MENU to place a 24-2 SITA SWAP button on Main Menu.

What clinical studies have been conducted an SITA SWAP?

Several studies have been conducted, and a few studies have already been released on SITA SWAP, specifically. A document listing some of these studies is attached in Appendix A.

What does a SITA SWAP printout look like?

Please see Appendix B for an example of a patient who was tested using both SITA SWAP and white an white perimetry. Note the similarity to SITA Standard printouts.

What if I want to purchase SITA SWAP, but 1 do not have a 745, 745i, 750, or 750i?

Upgrade your 740 or 740i to a 745 or 745i.

The yellowing in a cataract resulted in decreased sensitivity when using SWAP.

How do cataracts affect SITA SWAP?

SITA SWAP has a new normative database, the information in which helps account for some lenticular changes in older age groups [Note that lenticular changes produce an overall reduction in hill of vision].

As a result, SITA SWAP shows improved performance in patients having early to moderate cataract, compared with previous SWAP testing methods.

IOL patients seem to show greater than normal sensitivity (higher Mean Deviation) on SITA SWAP than expected. Why?

Patients having intraocular lenses typically have clearer vision than others in their age group, because a new, clear IOL has replaced an older, cloudy natural lens. Further, older patients that still have their natural lenses in place tend to have lenses that are yellow; this yellowing can block the blue light of the SITA SWAP stimuli.

What happened to the Three-in-One printout?

The Three-in-One plot for SITA SWAP has been replaced by the Single Field Analysis printout, which provides stronger clinical information such as probability maps GHT and PSD analysis derived from STATPAC™ analysis.

Appendix A
Selected clinical references: SWAP and SITA SWAP

Section Links

- SITA SWAP - General visual function applications
- SWAP - General visual function applications
- SWAP - Glaucoma applications
- SWAP - Neuro-ophthalmology applications
- SWAP - Age-related macular degeneration applications
- SWAP - Diabetes applications
- SWAP - Structure-Function Relationships

SITA SWAP - General visual function applications

„SITA SWAP test results from normal eyes showed higher sensitivities than results from the older Full Threshold SWAP. This represents an increase of the dynamic range, which implies that more patients can be tested with SWAP The smaller intersubject variability with SITA SWAP means narrower normal limits and may be associated with more sensitive probability maps."

> Bengtsson B, Heijl A., „Normal intersubject threshold variability and normal limits of the SITA SWAP and full threshold SWAP perimetric programs." Invest Ophthalmol Vis Sci. 2003 Nov; 44(11):5029-34.

„SITA SWAP was much faster than the older SWAP strategies, and reproducibility did not differ [Average test time was 3.6 minutes for SITA SWAP, 11.8 minutes for Full Threshold SWAP, and 7.7 minutes for Fastpac SWAP]. This implies that SITA SWAP could become a clinically useful method for the detection of early glaucoma. SWAP tests may also be applicable in larger groups of patients because of the increased dynamic range."

> Bengtsson B., „A new rapid threshold algorithm for short-wavelength automated perimetry." Invest Ophthalmol Vis Sci. 2003 Mar;44(3):1388-94.

SWAP - General visual function applications

„... SWAP is a powerful clinical tool able to detect visual field deficits 3 to 5 years before standard automated perimetry (white-on-white) in most glaucoma patients, and progression of visual field defects up to 3 years earlier. SWAP deficits are predictive of the onset and location of future visual field loss, and they correlate well with structural damage associated with glaucoma... Although SWAP was originally developed to detect visual loss in glaucoma patients, it is also useful for patients with diabetic retinopathy and maculopathy, optic neuropathies, vision loss associated with HIV, migraine, and multiple sclerosis. More sensitive psychophysical tests of visual function, such as SWAP, can significantly shorten clinical trials and aid in the validation of new therapeutic approaches."

> Racette L, Sample PA., „Short-wavelength automated perimetry." Ophthalmol Clin North Am. 2003 Jun;16(2):227-36, vi-vii.

„...(SWAP) is a more sensitive test than standard achromatic perimetry for early loss of vision due to glaucoma and other ocular and neurological diseases. SWAP is also more successful for detecting changes in vision as glaucoma progresses...“

Sample PA. „Short-wavelength automated perimetry: it's role in the clinic and for understanding ganglion cell function.“ Prog Retin Eye Res. 2000 Jul;19(4):369-83.

„Standard dosages of tamoxifen can affect SWAP visual fields. The effects of tamoxifen are not equivalent for SWAP and FDP, indicating that tamoxifen affects some types of visual pathways preferentially or selectively. SWS cone pathways, in particular, are affected. SWAP appears able to reveal effects of tamoxifen occurring years before completion of the standard 5 year regimen of use.“

Eisner A, Austin DF, Samples JR. „Short wavelength automated perimetry and tamoxifen use.“ Br J Ophthalmol. 2004 Jan;88(1):125-30.

SWAP - Glaucoma applications

„RNFL and SWAP losses are signs of early glaucomatous damage and can predict functional losses in standard automated perimetry.“

Polo V, Larrosa JM, Pinilla I, Perez S, Gonzalvo F, Honrubia FM. „Predictive value of short-wavelength automated perimetry: a 3-year follow-up study.“ Ophthalmology. 2002 Apr;109(4):761-5.

„...(SWAP) uses a bright yellow background and a large blue stimulus to isolate and measure the sensitivity of short-wavelength-sensitive mechanisms throughout the central 30 degrees visual field. After more than 8 years of cross-sectional and longitudinal studies of patients with early glaucoma, ocular hypertensive patients, and age-matched control subjects, SWAP has been shown to be a sensitive indicator of early damage and progression of loss in glaucoma...“

Johnson CA. „Diagnostic value of short-wavelength automated perimetry.“ Curr Opin Ophthalmol. 1996 Apr;7(2):54-8.

„Short-wavelength automated perimetry identified more patients than standard perimetry as having progressive glaucomatous changes of the optic disc. Compared with standard perimetry SWAP may improve the detection of progressive glaucoma.“

Girkin CA, Emdadi A, Sample PA, Blumenthal EZ, Lee AC, Zangwill LM, Weinreb RN. „Short-wavelength automated perimetry and standard perimetry in the detection of progressive optic disc cupping.“ Arch Ophthalmol. 2000;118:1231-1236.

„The performance of SWAP, FDT, and TMP suggests that these test types may all be suitable for detection of early loss of visual function in glaucoma. Ganglion cell subpopulations with lower levels of redundancy and/or these with larger cell sizes offer the most parsimonious explanation for earliest ganglion cell losses occurring in glaucoma.“

Spry PG, Johnson CA, Mansberger SL, Cioffi GA. „Psychophysical investigation of ganglion cell loss in early glaucoma.“ J Glaucoma. 2005 Feb;14(1):11-9.

„... SWAP is likely to correspond to abnormalities in optic disk topography at an earlier stage of glaucomatous optic neuropathy than SAP. Therefore, clinicians should consider SWAP testing in glaucoma suspects to detect glaucomatous visual field loss at an earlier stage of structural loss."

Mansberger SL, Zangwill LM, Sample PA, Choi D, Weinreb RN. „Relationship of optic disk topography and visual function in patients with large cup-to-disk ratios." Am J Ophthalmol. 2003 Nov;136(5):888-94.

„These findings suggest that what appeared to be unilateral visual field defects may in fact have been bilateral in at least 33.3% of our patients (n = 6) for whom there was agreement between results of SWAP and the nerve fiber layer analyzer."

Susanna R Jr, Galvao-Filho RR „Study of the contralateral eye in patients with glaucoma and a unilateral perimetric defect." J Glaucoma. 2000 Feb;9(1):34-7.

„The SWAP results that were found in the ocular hypertensive eyes were associated with other risk factors that have been reported to be predictive of the development of glaucomatous visual field loss, especially the vertical cup-to-disc ratio and age. These findings support the notion that the SWAP deficits represent early glaucomatous damage and may be related to early changes that occur at the optic nerve head."

Johnson CA, Brandt JD, Khong AM, Adams AJ. „Short-wavelength automated perimetry in low-, medium-, and high-risk ocular hypertensive eyes." Initial baseline results. Arch Ophthalmol. 1995 Jan;113(1):70-6.

„At baseline, 25 (78.1 %) of the 32 eyes exhibited larger deficits with blue-on-yellow perimetry, five (15.6%) had equivalent loss with both tests, and two (6.3%) had larger deficits with standard white-on-white perimetry. Seven (21.9%) of the 32 eyes demonstrated evidence of progressive visual field loss with standard white-on-white perimetry in 5 years... Blue-on-yellow perimetry is effective in predicting which patients with early glaucomatous visual field loss are most likely to have progressive loss. The rate of progressive loss is greater with blue-on-yellow perimetry than with standard white-on-white perimetry."

Johnson CA, Adams AJ, Casson EJ, Brandt JD. „Progression of early glaucomatous visual field loss as detected by blue-on-yellow and standard white-on-white automated perimetry." Arch Ophthalmol. 1993 May;111(5):651-6.

„...Five years later, five of the nine ocular hypertensive eyes with initial B/Y [SWAP] abnormal results developed glaucomatous visual field loss measured by standard W/W automated perimetry while none of the 67 ocular hypertensive eyes with initially normal B/Y results developed abnormal W/W perimetry results... Blue-on-yellow perimetry deficits are an early indicator of glaucomatous damage and are predictive of impending glaucomatous visual field loss for standard W/W automated perimetry. To our knowledge, this is the first prospective, long-term longitudinal study that demonstrates the ability to predict the onset of glaucomatous visual field loss in patients with ocular hypertension an the basis of psychophysical testing."

Johnson CA, Adams AJ, Casson EJ, Brandt JD. „Blue-on-yellow perimetry can predict the development of glaucomatous visual field loss." Arch Ophthalmol. 111; 645-650, May 1993.

„...The predictive ability of the test was assessed in 25 eyes followed up for more than one year, five of which developed glaucoma. These five eyes and those at high risk showed higher mean defect (P < .0001) and number of defective points (P < .0001) than the other suspect groups, which were not significantly different from normal eyes... Color visual fields identify early functional loss in eyes at greatest risk for primary open-angle glaucoma."

Sample PA, Taylor JD, Martinez GA, Lusky M, Weinreb RN. „Short-wavelength color visual fields in glaucoma suspects at risk." Am 1 Ophthalmol. 1993 Feb 15;115(2):225-33.

SWAP - Neuro-ophthalmology applications

„Preliminary findings suggest that SWAP may be useful in detecting certain neuro-ophthalmologic deficits more readily than standard automated visual field testing, especially for optic neuritis and multiple sclerosis..."

Keltner JL, Johnson CA. „Short-wavelength automated perimetry in neuro-ophthalmologic disorders." Arch Ophthalmol. 113:475-481, April 1995.

SWAP - Age-related macular degeneration applications

„...In a prospective cross sectional study, 126 patients...with ARM ... were tested...Mean sensitivity and standard deviation of all patients exhibited a significant reduction with age. Patients with soft drusen had significantly lower sensitivity than those without...Sensitivity was also reduced in those eyes with fellow eyes having a sight threatening complication of age related macular degeneration (AMD).... [SWAP] sensitivity loss is associated with common risk factors for progression to AMD. Short wavelength automated perimetry is moderately rapid and readily available. It may serve as a tool in future ARM trials.

Remky A, Lichtenberg K, Elsner AE, Arend O. „Short wavelength automated perimetry in age related maculopathy." Br J Ophthalmol. 2001 Dec;85(12):1432-6.

SWAP - Diabetes applications

„Both mfERG and SWAP are sensitive measurements of diabetic dysfunction, even prior to retinopathy. The lack of spatial correspondence between mfERG and SWAP abnormalities in diabetic patients with no retinopathy reflects overlapping, but different, retinal anomalies in early diabetic eye disease."

Han Y, Adams AJ, Bearse MA Jr, Schneck ME. „Multifocal electroretinogram and short-wavelength automated perimetry measures in diabetic eyes with little or no retinopathy." Arch Ophthalmol. 2004 Dec;122(12):1809-15.

„... SWAP may act as an early detector of visual function loss in early diabetic maculopathy and serve as a helpful technique to predict early ischemic damage of the macula and to monitor therapy."

Remky A, Arend O, Hendricks S. „Short-wavelength automated perimetry and capillary density in early diabetic maculopathy." Invest Ophthalmol Vis Sci. 2000 Jan;41(1):274-81.

„The fields of 8 patients were abnormal as assessed by conventional perimetry while all were classified as abnormal using short-wavelength perimetry. In the 8 patients who exhibited both abnormal conventional and abnormal short-wavelength perimetry results, the extent of field loss was generally greater using short-wavelength perimetry. The position of the localised field loss (i.e. as distinct from field loss that was generalised across the visual field) assessed by short-wavelength perimetry corresponded with the clinical mapping of the area of diabetic macular oedema but the extent of this loss was generally greater than that suggested by clinical assessment. Short-wavelength automated perimetry offers improved sensitivity for the psychophysical detection of clinically significant diabetic macular oedema."

Hudson C, Flanagan JG, Turner GS, Chen HC, Young LB, McLeod D. „Short-wavelength sensitive visual field loss in patients with clinically significant diabetic macular oedema." Diabetologia. 1998 Aug;41(8):918-28.

SWAP - Structure-Function Relationship

„Retinal nerve fiber layer thickness measured with OCT is topographically correlated with glaucomatous VF defects measured with SWAP."

Sanchez-Galeana CA, Bowd C, Zangwill LM, Sample PA, Weinreb RN. „Short-wavelength automated perimetry results are correlated with optical coherence tomography retinal nerve fiber layer thickness measurements in glaucomatous eyes."Ophthalmology. 2004 Oct;111(10):1866-72.

„OCT RNFL measurements appear to correlate well with SWAP abnormalities in glaucoma, and may detect glaucomatous damage earlier than standard conventional automated perimetry. This study suggests that OCT may recognize the earliest evidence of structure alterations in CPOAG."

Mok KH, Lee VW, So KF. „Retinal nerve fiber layer measurement by optical coherence tomography in glaucoma suspects with short-wavelength perimetry abnormalities." J Glaucoma. 2003 Feb;12(1):45-9.

Appendix B
Case exampie: SITA SWAP versus White an White.

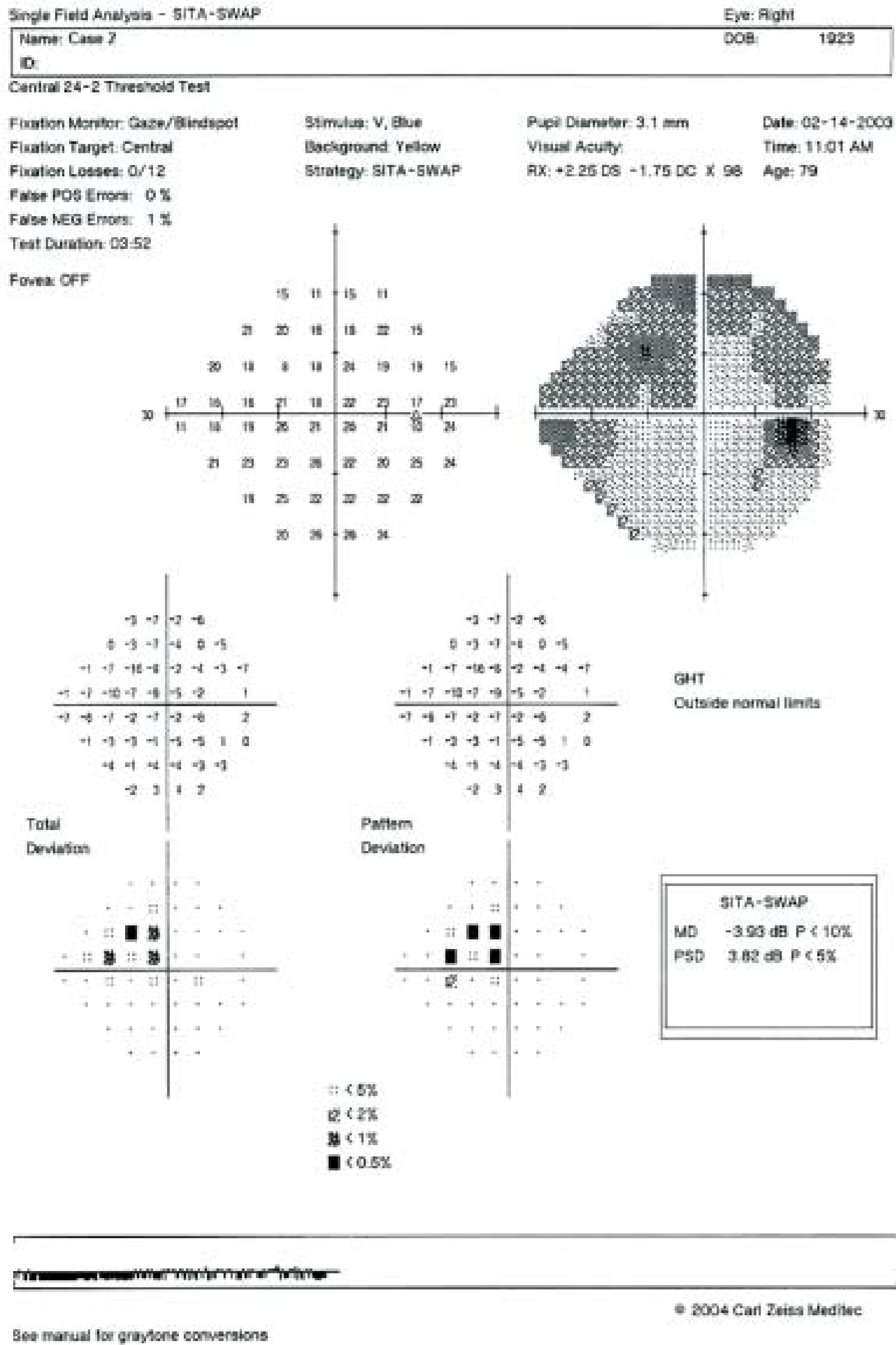

Figure 1: SITA SWAP printout showing early paracentral defects in the superior hemifield of a patient's right eye. Both MD and PSD global indices are flagged, with PSD marked at the 5% limit.

SINGLE FIELD ANALYSIS EYE: RIGHT

NAME: Case 2 DOB: 1923

ID:

CENTRAL 24-2 THRESHOLD TEST

FIXATION MONITOR: BLINDSPOT STIMULUS: III, WHITE PUPIL DIAMETER: 3.1 MM DATE: 02-14-2003

FIXATION TARGET: CENTRAL BACKGROUND: 31.5 ASB VISUAL ACUITY: TIME: 11:25 AM

FIXATION LOSSES: 0/11 STRATEGY: SITA-FAST RX: +2.25 DS -1.75 DC X 90 AGE: 79

FALSE POS ERRORS: 2 %

FALSE NEG ERRORS: 0 %

TEST DURATION: 02:47

FOVEA: OFF

TOTAL DEVIATION

PATTERN DEVIATION

GHT
WITHIN NORMAL LIMITS

MD +0.63 DB
PSD 1.35 DB

:: < 5%
⊞ < 2%
▩ < 1%
■ < 0.5%

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HFA II 750-2100-5.SWAP.1.04-1.SWAP.

Figure 2: Same example, but the visual field test was performed with standard white an white perimetry. Here, GHT indicates the visual field is „Within Normal Limits", while the previous SITA SWAP example shows GHT as „Outside Normal Limits." This patient was confirmed to have glaucomatous changes that were recognized early with SITA SWAP.

When your patients entrust you with their eyesight, their vision and your expertise converge. For the world's most advanced surgical and diagnostik solutions in ophthalmology, you can turn to Carl Zeiss Meditec. We're committed to earning your trust anew, every day.

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