Gamma hedging of 0DTE options: Managing extreme risk on expiration day

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When numbers matter

Contents

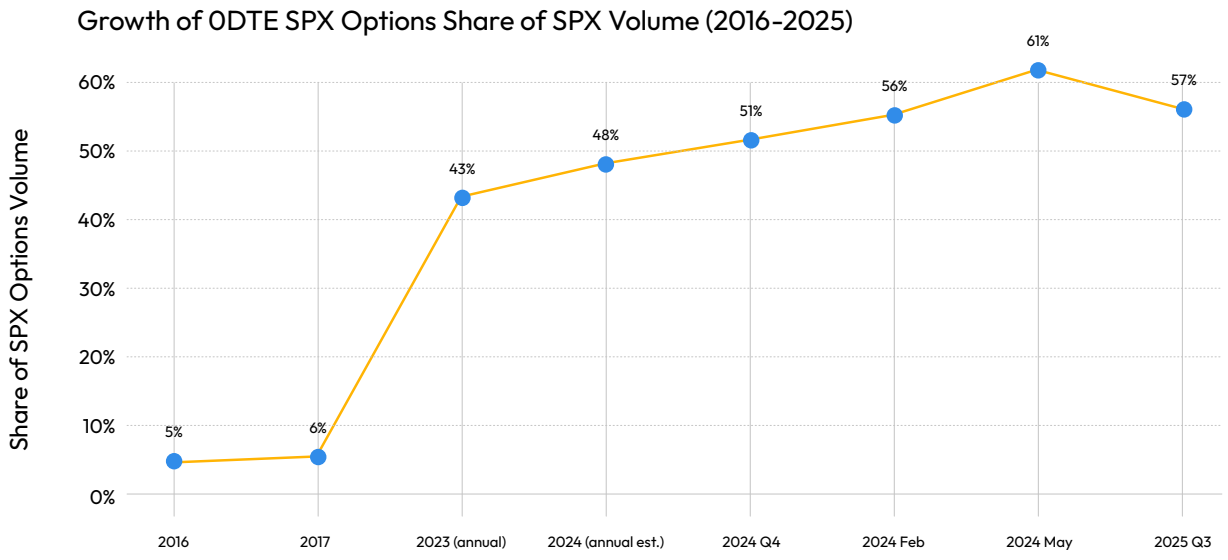
1. The rise of 0DTE options

Over the past few years, zero days to expiration (0DTE) options on US equity indices have moved from a niche product to a central component of daily market activity. These contracts, which expire on the same day they are traded, now account for an outsized portion of index option volume (over 61% in the S&P 500 (SPX) as of May 2025)[1].

Exchanges like Cboe accelerated this trend by introducing daily expirations for key index options in 2022, enabling traders to continuously roll very short-term positions. The result is a "near-continuum" of expiring strikes each day, and volumes have snowballed as both retail and institutional players embraced 0DTE trading[2].

Figure 1: Growth of 0DTE options: Zero-day options have become more popular

The share of S&P 500 index options volume coming from 0DTE (same-day expiry) contracts has grown dramatically in recent years, from a mere 5% in 2016 to over 61% of volume by May 2025.



Sources: Cboe Volatility Insights (2016 baseline, 2023 annual), Option Alpha & Benzinga (2024 est.), Cboe Q4 2024 report (51%), IB Traders' Insight (Feb 2025), MarketWatch/Morningstar (May 2025), Cboe State of Options Industry Q3 2025 (57%).

Targeted uses

Initially popular among retail traders for quick, leveraged bets, 0DTE options have increasingly been adopted by professional desks for tactical purposes[3]. Hedge funds may use same-day options to hedge intraday event risk (like a US Federal Reserve (Fed) announcement) or to sell very short-dated premium and capture intraday time decay.

[1] Morningstar. Popular 'zero-day' options saw record share of trading volume in May as retail traders piled in. Jun 2, 2025
[2] Resonanz Capital. Same-Day Options, Same-Day Alpha? Institutional Lessons from 0DTE's Boom, 30 June, 2025
[3] Resonanz Capital. Same-Day Options, Same-Day Alpha? Institutional Lessons from 0DTE's Boom, 30 June, 2025

A key appeal is that 0DTEs carry no overnight risk, since positions are opened and closed within the same trading day. This allows traders to express short-term views or manage daily exposures without longer-term commitments. Market-makers, on the other hand, provide liquidity in these options throughout the day, relying on speed and pricing acumen to manage the inventory risks that can swing violently with intraday order flow[4].

The risk management challenge

The flip side of 0DTE convenience is an extreme risk profile. With lifespans measured in hours or minutes, these options exhibit a unique Greek behavior. Vega (volatility exposure) is minimal due to the short timeframe, but gamma (delta sensitivity) and theta (time decay) are off the charts[5]. This means a trader holding 0DTE options faces a rapidly shifting risk landscape. The position's delta can change significantly in minutes with market moves, and any extrinsic value will erode to zero by the closing bell.

Managing these fast-moving risks is extremely challenging. It demands constant monitoring and lightning-fast hedging decisions to avoid being caught by a sudden swing or to capture a profit opportunity if long gamma. What might be a mild intraday wobble in the S&P 500 can, if unhedged, inflict outsized losses on a large 0DTE option position due to the leverage and gamma involved.

Concerns and market impact

The explosive growth of 0DTE trading has prompted debate about broader market stability. Some commentators have feared that heavy same-day options activity could lead to volatile feedback loops. For instance, if market-makers are caught short gamma and forced to buy into a rally or sell into a decline, they could amplify the directional move (the classic "tail wagging the dog" scenario).

In fact, 0DTE gamma hedging was blamed by various media for both exacerbating intraday volatility and suppressing it[6]. Large long gamma positions can often stifle index movement as market-makers gamma hedge each small move in the index to secure enough profit to offset their mounting theta decay.

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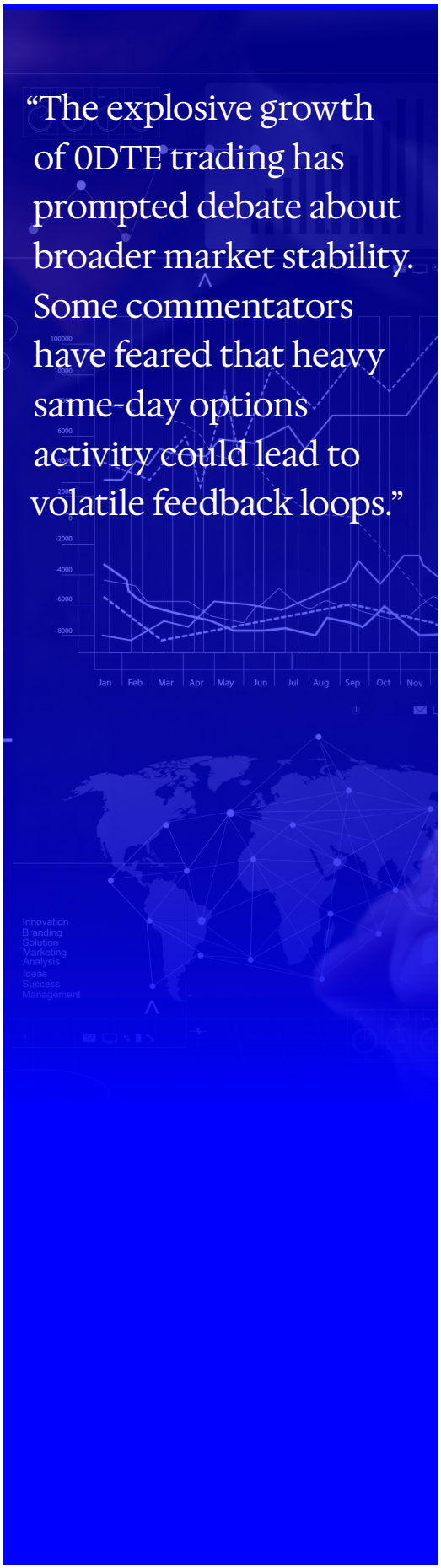

[4] Resonanz Capital. Same-Day Options, Same-Day Alpha? Institutional Lessons from 0DTE's Boom, 30 June, 2025

[5] Resonanz Capital. Same-Day Options, Same-Day Alpha? Institutional Lessons from 0DTE's Boom, 30 June, 2025

[6] Cboe. Volatility Insights: Much Ado About 0DTEs – Evaluating the Market Impact of SPX 0DTE Options, Many Xu, 8 September, 2023

However, empirical studies and exchange data suggest that thus far, the net market impact of 0DTE flows has been limited. Customer order flow in these options tends to be remarkably balanced between buyers and sellers, leaving market-makers with relatively small net gamma exposures on average[7].

For example, Cboe data shows that even late in the trading day, the typical net gamma exposure of market-makers from 0DTE options corresponds to only a tiny fraction (<1%) of overall S&P 500 futures volume[8]. Moreover, analysis of S&P 500 intraday volatility before and after the rise of 0DTE options found no significant increase in abrupt price swings attributable to these instruments[9]. In short, while 0DTE gamma effects can create noticeable intraday patterns (such as "pinning" the index level near a strike with high open interest in the final hour), the systemic impact appears contained so far.

From a market-wide perspective, 0DTE options have not (yet) destabilized trading. From an individual trader's perspective, however, the risk is very real and extreme. This paper will focus on that micro-level risk management problem: how can a professional trading desk safely manage the ultra-short-term Greeks of 0DTE options?

Our aim is to equip institutional market participants with a clearer understanding of how to harness 0DTE options as a tool (the "precision scalpel"), while avoiding unwanted explosions (the "landmine").

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2. 0DTE Greeks overview: Why delta & gamma dominate on expiration day

It is important to recap which risk parameters (Greeks) matter most for 0DTE options and why traditional measures change character as expiration nears.

Delta (Δ): Delta measures an option's sensitivity to the underlying price, essentially the effective index exposure of the option position. For an index call, delta ranges from 0 to +1 (0 to 100% of equivalent index exposure); for a put, from 0 to –1. An at-the-money (ATM) option typically has $\Delta \approx 0.5$ in mid-life. Market-makers and hedgers closely monitor delta since they often aim to stay "delta-neutral" (offsetting any option delta with an opposite position in the underlying index or futures).

On expiration day, delta can change from moment to moment as the option goes in or out of the money. If held to the 4:00pm close, an option's delta effectively jumps to 0 or 1 at settlement – meaning it either expires worthless or converts to an equivalent underlying position (for the ETF option) or cash payment (for the futures option). This binary outcome looms large in the final minutes.

Gamma (Γ): Gamma is the rate of change of delta with respect to the underlying price. It is usually viewed as a "second order" Greek, but on expiration day it is the primary source of risk dynamics. High gamma means the option's delta will fluctuate sharply for small moves in the index. Crucially, gamma is highest for ATM options near expiration. As time to expiry shrinks, the delta of an ATM call or put becomes incredibly

[7] Cboe. 0DTEs Decoded: Positioning, Trends, And Market Impact. Mandy Xu, May 2, 2025

[8] Diversification.com. Can Zero-Day Options Really Drive Volatility? Alexander Harmsen.

[9] Cboe. Volatility Insights: Much Ado About 0DTEs – Evaluating the Market Impact of SPX 0DTE Options, Many Xu, 8 September, 2023

sensitive – essentially poised to swing toward 1 or 0 with any slight uptick or downtick in the index.

Gamma risk grows exponentially as expiration approaches. What might be a moderate gamma for a one-week option can become a gigantic gamma on the day of expiry. For example, a near-expiry S&P 500 call with only an hour left might have a gamma several times larger than it had even one day earlier.

This implies that if the index moves by 0.5% or 1% intraday, the option's delta could change by tens of percentage points in minutes – a dramatic shift in exposure. Gamma is the reason 0DTE option holders must rebalance constantly. Without hedging, the delta surge from a market move can leave a trader abruptly over-exposed (long or short) at the worst possible time.

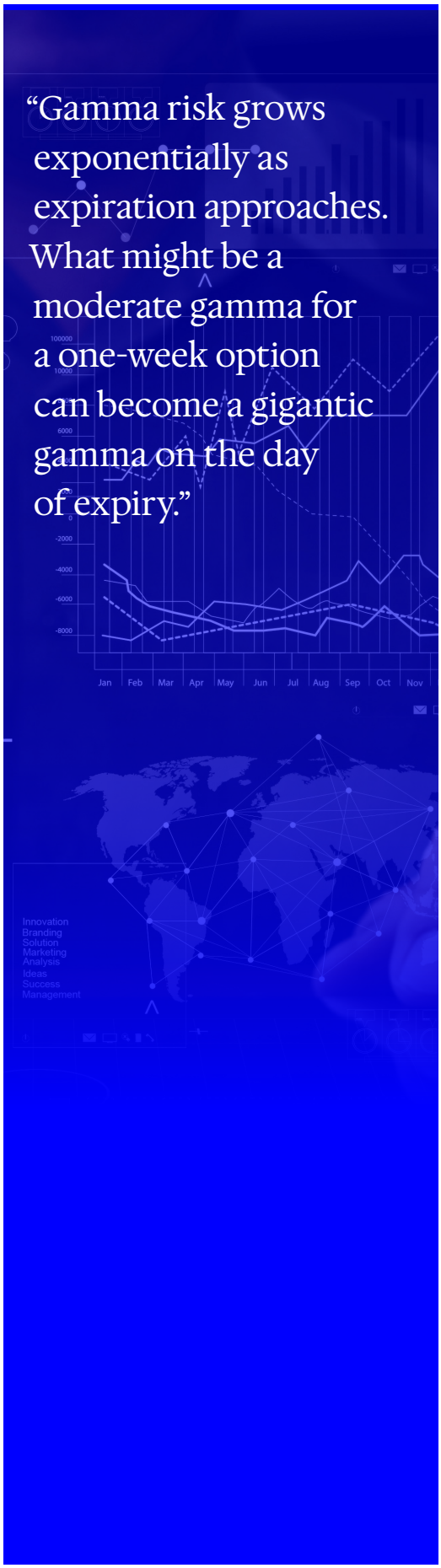
Theta (Θ): Theta measures the option's time decay – the loss of extrinsic value as time passes. All else equal, an option loses value as it nears expiry (benefiting the seller, hurting the buyer). For 0DTE options, theta is extremely large in absolute terms, because all time value must decay to zero by the end of the trading day. An ATM option that might be worth several dollars in the morning will either be worthless or fully in-the-money by the close.

This intense intraday time decay is what attracts many traders to sell 0DTE premium (seeking to harvest theta). However, theta's effect is entangled with gamma. An option can lose value from time decay until a market move intervenes, in which case delta and gamma will dominate the price change.

Thus, selling 0DTE options for theta gains is essentially a bet that realized volatility will remain low throughout the day. If a large move occurs, gamma can easily overwhelm the day's theta gains. Successful intraday premium sellers often rely on active gamma hedging to make sure sudden index moves do not erase the gradual profits from theta.

Conversely, traders with long gamma positions need to beware of low volatility situations, as they will experience heavy theta decay if the underlying doesn't move.

Vega (v): Vega measures sensitivity to changes in implied volatility. Uniquely for 0DTE, vega is relatively small. With so little time remaining, even a jump in implied volatility has a limited effect on price, unless it is an extremely large move. (In fact, Cboe's one-day VIX (VIX1D) index was introduced to help gauge daily implied volatility, as the traditional 30-day VIX is not very sensitive to 0DTE dynamics.)



While vega risk is not zero – an important news headline at 2pm, for instance, could momentarily lift implied volatility for options expiring that afternoon – it is generally a secondary concern. Traders often ignore vega for intraday positions except around scheduled events, when implied volatility may rise prior to the event, and then drop sharply post-event.

Thus, the primary focus for risk management on expiration day remains on delta and gamma, with theta in mind as the end-of-day reward or cost.

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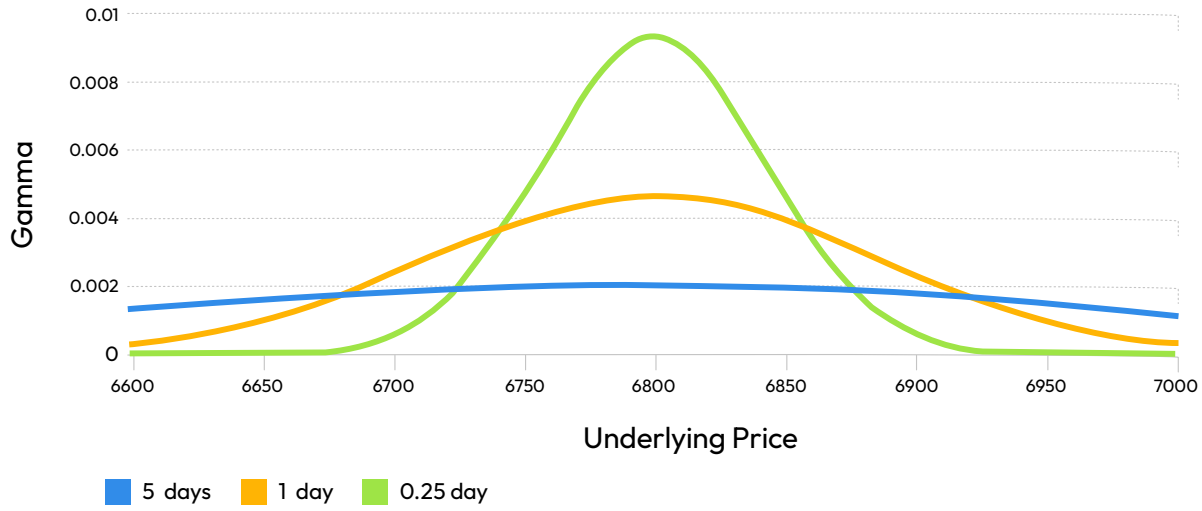
3. Explosive gamma: Why risk peaks at the last hour

By definition, the closer an option is to expiring, the more binary its outcome. This drives the gamma up dramatically for near-expiry ATM options. To visualize this, consider how an ATM option's gamma profile tightens and grows as time shrinks:

Figure 2: Gamma vs. underlying price as expiration approaches.

This chart shows the gamma of an at-the-money index option (strike = 6800) at three different times to expiry (approx. 5 days, 1 day, and 0.25 day).



Source: Options Depth

The chart illustrates the nearer to expiration (orange line), the higher and narrower the gamma peak around the ATM price. In the final hours, gamma spikes steeply at the money, indicating that even a tiny deviation in the underlying's price will cause a large jump in delta. This illustrates a hallmark of 0DTE risk that ultra-high gamma is concentrated in a very small price range.

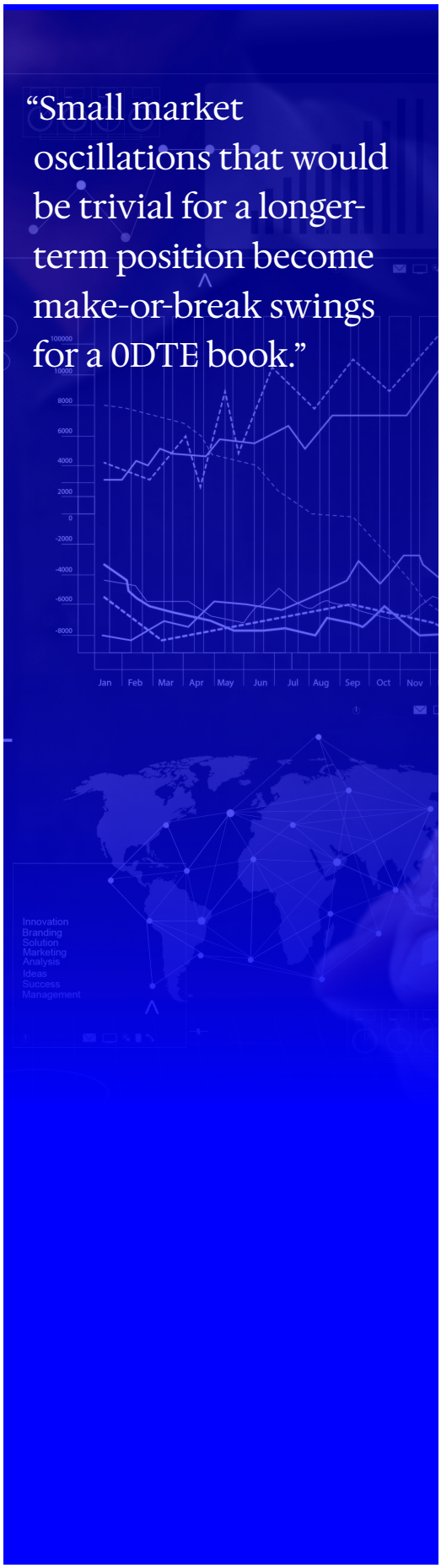
Essentially, when an index level is hovering near an option's strike on expiration day, the option's delta is highly unstable. It is poised to flip from ~50% towards 100% or 0%, with any minor move. Traders describe this situation as "sitting on a knife-edge." The gamma is so large that a 0.1% index move can feel like a major shock to a position's exposure.

To put numbers to it, suppose at noon the S&P 500 is exactly at an option's strike (ATM = 6800) with 2 hours until expiry. The option might have a delta ≈ 0.50 at that moment. If the index rallies just 1% (a 68-point move) in the afternoon, that call's delta could jump to ~0.95 as it's now deeply in-the-money. Conversely, if the index falls 1%, the call's delta might drop to ~0.05 (nearly zero).

In either direction, the delta has swung by ~0.45 – meaning the option went from behaving like a half-sized index position to behaving almost like a full index (or no index) position. For a trader who was short that call, this is dangerous. A suddenly high delta means the position is now very short the market (synthetically) without the trader having intended it. And it can happen fast. In our example, that ~1% move could occur in minutes on an active day. The trader's exposure would have changed drastically in that short span, unless they intervened by hedging along the way.

This phenomenon is why risk peaks in the final hour for short-term options. Gamma is at its zenith, so delta exposure can explode unpredictably. Small market oscillations that would be trivial for a longer-term position become make-or-break swings for a 0DTE book. Many seasoned option desks choose to de-risk or close out 0DTE positions before the final 30 minutes of trading, precisely because of this unpredictable gamma. In fact, some clearing firms mandate that 0DTE positions be flattened by 3:45pm (15 minutes before close) to avoid last-minute chaos[10].

If unexpected news or a sudden order flow imbalance hits in those last minutes, an option's value can double or evaporate almost instantly, and there's virtually no time to respond.



[10] Resonanz Capital. Same-Day Options, Same-Day Alpha? Institutional Lessons from 0DTE's Boom, 30 June, 2025

4. Gamma hedging in practice: Continuous delta rebalancing

Gamma hedging refers to the routine of adjusting a position's delta hedge over time to capture small profits or, more importantly, to control risk from gamma. On expiration day, continuous delta rebalancing is not optional – it's a necessity. Without it, a trader with a short-term options position is effectively gambling on the market not moving or moving significantly (depending on the position), which is a recipe for disaster if the market doesn't behave as expected. Professional market-makers and option desks are well aware of this, so they hedge gamma throughout the day by buying or selling the underlying index future or ETF in response to price changes.

How gamma hedging works

In principle, the process is straightforward:

1. **Start delta-neutral.** The trader begins with a hedged position. For example, if they sold an ATM call, they buy a quantity of S&P 500 futures or ETF shares to offset the -0.5 delta of that short call. Net delta = 0 at the start.
2. **The market moves and delta shifts.** As the underlying index moves, the option's delta changes because of gamma. Suppose the market rises – the short call's delta becomes more negative (it behaves more like a short futures position as it goes in-the-money). Now the trader's initial hedge (long futures) is not enough. The position has developed a net negative delta (essentially a shortfall in the hedge).
3. **Rebalance (buy or sell underlying).** The trader quickly trades the underlying to neutralize delta again. In our example of a rising market with a short call, the trader buys more futures to catch up with the call's greater negative delta[11]. If the market had fallen (and the short call delta became less negative), the trader would sell some of the futures (since the position had developed a net positive delta). After this trade, the overall position is back to delta = 0.
4. **Repeat frequently.** These steps repeat for each meaningful price swing. In effect, the trader is "chasing" the underlying price: when short gamma, they hedge with the move (buy as it goes up, sell as it goes down) to avoid compounding losses. If the trader were long gamma (e.g., long a straddle), they would do the opposite – hedging against the move (sell into rallies, buy into dips) to lock in small profits as the market oscillates[12]. Either way, multiple hedge trades are done intraday, sometimes rapidly one after another in volatile markets.

The end result of gamma hedging is that the trader's position remains near delta-neutral at all times despite the underlying's gyrations. This is crucial for risk management. It prevents a scenario where the market runs away, and the trader is left with an unhedged directional exposure.

Essentially, gamma hedging converts what would be a non-linear, potentially runaway profit and loss (P&L) profile into a series of smaller linear segments. Each hedge trade realizes a loss or profit that, for a short gamma trader, offsets the option's theoretical P&L change over that interval. For a long gamma trader, each hedge locks in a small profit (buying low, selling high), which ideally accumulates to exceed the option's time decay cost.

[11] Menthor. Understanding 0DTE Gamma Exposure

[12] Menthor. Understanding 0DTE Gamma Exposure

5. Rapid hedging tools and techniques: Technology for real-time risk control

Handling 0DTE gamma risk is as much a technology challenge as it is a trading skill. Professional options desks deploy advanced tools to monitor Greeks in real-time and execute hedges with minimal latency. Below, we outline key components of a 0DTE risk management toolkit used by leading market participants (such as market-makers and hedge funds) which are all aimed at enabling the rapid hedging and decision-making needed on expiration day.

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Real time Greek analytics

Traders use high-performance risk systems that continuously calculate each position's Greeks (delta, gamma, vega, theta) based on live market data. These systems update multiple times per second, especially for 0DTE options where sensitivities change quickly. Real-time Greek analytics allow the desk to know exactly how much delta exposure they have at any given moment and how fast it is changing.

For instance, a market-maker's dashboard might show that for a 1-point move in the S&P, their net delta will change by ±$X million (this is net gamma exposure). This is a critical number to track. One must "monitor intraday risks with speed," as experts say, by watching Greeks, open interest for key strikes, and other metrics live on-screen[13]. The moment those indicators flash that delta has exceeded risk thresholds or gamma exposure is mounting, the trader can act.

Automated delta hedging algorithms

Given the need to hedge a market move within seconds (or faster), many professional desks leverage algorithmic trading tools to execute hedges. These can range from simple "delta band" algorithms (which automatically buy/sell a preset number of futures when delta hits a threshold), to fully dynamic auto-hedgers that continuously trade futures to target zero net delta.

Market-makers often integrate such algorithms with their quoting systems. As they trade options and accumulate gamma exposures, the system instantly starts offsetting the risk by trading the underlying asset. This automation is crucial because manual execution might lag in a fast market.

An options market-maker might, for example, use a "delta ladder" that triggers a small futures buy every time the S&P drops ten points (when they are long gamma) or a futures sell if it rises ten points (when long gamma), according to a pre-defined hedge plan. The key is minimal latency. Co-located servers and direct exchange connections are used so that hedge orders can be sent out in milliseconds.

Automated hedging ensures there is a rapid reaction during the entire trading day.

[13] Risk.net. Zero-day options: unique market dynamics and risk considerations, 2 April 2024

High-speed data and pricing engines

In the realm of 0DTE options, data timeliness is critical. Firms invest in ultra-low-latency market data feeds and fast option pricing engines. A delay of even a few milliseconds could mean an options pricing model is outdated by a tick, leading to a bad quote or a misjudged hedge size. Systems are finely tuned to handle the "plumbing" of rapid quote updates and hedge orders without lag.

For instance, if a volatility input or option price does not update immediately after a big trade, a trader could momentarily be using out-of-date information. Robust technology and infrastructure help prevent such gaps. Some desks employ predictive models or dynamic tolerances that anticipate how delta and gamma will shift with the next price tick, essentially hedging proactively rather than reactively.

Risk limit alerts and kill-switches

Even with automation, human oversight and risk controls are paramount. Desks set pre-defined limits on position sizes or exposures they are willing to carry. For example, a hedge fund might set a rule that net gamma exposure (for a 1% move) must remain below a certain dollar value, or that a single strike's short position must be below a contract count limit.

Real-time alerts will trigger if these limits are approached or exceeded, prompting traders to reduce positions or add hedges. In extreme cases, "kill-switch" mechanisms can automatically start liquidating positions if losses exceed a threshold or if delta cannot be reined in. Such tools act as a last resort to prevent a blow-up on a day when hedging might fall behind (for instance, if the market makes a sudden 3% intraday jump that overwhelms normal hedging capacity).

Visualization: Gamma exposure maps and scenario analysis

Advanced risk management technologies includes visual tools to map out potential problem areas. One popular tool is a "gamma exposure" (GEX) map of the index, which shows the points of heavy open interest and whether dealers are net long or short gamma at various strikes. This helps traders anticipate where "gamma walls" might pin the market or where a breach could cause a flurry of hedging activity.

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For instance, if there is an enormous concentration of 0DTE put open interest at a certain strike slightly below the current index level, a risk manager knows that if the market dips to that level, short gamma hedging could accelerate a sell-off (or conversely, support the market if dealers are long gamma there). Additionally, scenario analysis tools allow traders to simulate what-if moves: "If the S&P drops 1% in the next 30 minutes, how will my delta and P&L change?"

By running these scenarios continuously, traders can gauge how aggressive their hedging needs to be. Modern systems can update these projections on the fly, effectively giving a forward-looking radar of one's risk.

Execution coordination and liquidity management

On busy expiration days, especially quarterly "quadruple witching" days or days with huge 0DTE volumes, even executing hedges without moving the market can be a skill. Professional desks use tactics like slicing hedge orders into small pieces, using liquid instruments (S&P 500 E-mini futures are a favourite for hedging SPX options, due to deep liquidity), and sometimes using proxy hedges (like hedging SPX options with SPY ETF shares or Nasdaq options with QQQ if needed for liquidity or overnight considerations).

Some also utilize volatility trading instruments like VIX futures or non-0TDE expiries if direct hedging becomes too costly or if traders want to hedge vega and gamma in tandem. The important point is that the hedge trades themselves must be executed efficiently – paying overly wide bid-ask spread on dozens of futures trades can eat heavily into profits or add to losses.

Electronic market-makers, in fact, thrive partly because they earn the bid-ask spread while hedging and can cross offsetting flows – an advantage that proprietary desks may not have, so they must be mindful of transaction costs.

> "Gamma hedging is not free money – it incurs trading costs. Bid-ask spreads, commissions (though many are minimal now), market impact of one's hedge trades, and slippage all add up."

Cost of continuous hedging

Gamma hedging is not free money – it incurs trading costs. Bid-ask spreads, commissions (though many are minimal now), market impact of one's hedge trades, and slippage all add up. Studies have pointed out that for most investors, "the economic feasibility of intraday delta hedging may be challenging" once these costs are considered[14].

Market-makers can do it cheaply because they internalize spreads and often have offsetting order flow. Additionally, their commission fees are usually extremely low and they may receive exchange rebates for large volume levels. On the other hand, a hedge fund or asset manager must weigh the cost. Aggressively hedging every tiny move will keep risk low but could consume the entire expected profit in transaction costs. Thus, part of the skill in 0DTE risk management is finding the right hedging frequency and size – balancing responsiveness with cost-efficiency.

[14] Risk.net. Zero-day options: unique market dynamics and risk considerations, 2 April 2024

Many professional desks will set a delta threshold (say, whenever net delta hits 100 futures-equivalents, they hedge) rather than hedge every single point of index movement. This creates a balance where minor oscillations are tolerated (within limits), but any move beyond is immediately corrected. The threshold can even adapt based on the time of day (e.g., tighten the threshold in the last hour when gamma is highest).

Human oversight

Finally, even the best systems are overseen by experienced risk managers and traders. On a busy expiration afternoon, one can picture a trading desk with eyes glued to screens: one showing live Greeks, one showing the S&P 500 tick chart, another with order execution dialogs, and perhaps one with news feeds (as an unexpected news shock is the ultimate wildcard on expiration days).

The team may hold periodic check-ins: "Our gamma exposure is climbing as we approach that 6800 strike – do we need to reduce positions?" or "It's 3:30pm, let's start unwinding to avoid an end-of-day liquidity crunch." Professional risk management culture encourages having pre-planned responses for various scenarios (for example, a plan for what to do if the market moves x% against a short position, or if liquidity dries up near the close). This preparation, combined with high-speed tools, is what allows savvy desks to survive and even thrive in the 0DTE arena where risk changes by the second.

> "0DTE options have become indispensable tools in the market, offering flexibility and opportunities for those equipped to handle them. For professional desks, the challenge is to manage the extreme short-term risks through vigilant hedging and sophisticated tools."

7. 0DTE options: An indispensable tool if managed well

0DTE options have become indispensable tools in the market, offering flexibility and opportunities for those equipped to handle them. For professional desks, the challenge is to manage the extreme short-term risks through vigilant hedging and sophisticated tools. Done correctly, one can navigate expiration day volatility and even capitalize on it – turning that "landmine" back into a "precision scalpel." But complacency or lack of preparation can be ruinous on expiration day. By focusing on gamma exposures and rapid hedging capabilities, global institutions can confidently utilize 0DTE options as part of their trading and risk management arsenal, while keeping extreme expiration-day risks well in check.

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