

ELBOW LOAD AND WHAT ACTUALLY LOWERS IT

# Position, Not *Effort*

You cannot throw your way to a lower elbow bill. Asking for less effort barely moves the load, and the levers that do move it are all positions and timings, spread across the whole delivery rather than concentrated at the arm.

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Elbow load is set by **where the arm is** and **when things happen**, not by how hard he is trying.

That single fact rules out the intervention most programs reach for first. Backing off the throttle does almost nothing, because perceived effort and elbow torque are not the same variable and do not move together. What does work is unglamorous: seven measurable positions, each worth a small amount, none of them located at the elbow, and none of them producing a headline improvement on its own.

## Effort does not work, and the numbers are stark

Worth leading with, because this is the belief that has to go before anything else can be useful.

| WHAT REDUCED EFFORT ACTUALLY REDUCES             |                                                                                             |                                                                                                                                   |
|--------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| WHAT WAS ASKED FOR                               | WHAT THE ATHLETE PRODUCED                                                                   | WHAT IT MEANS                                                                                                                     |
| <b>75 to 80 percent effort</b>                   | 80 to 95 percent of full effort elbow torque                                                | A quarter off the perceived effort buys somewhere between five and twenty percent off the load. The rest is still being paid.     |
| <b>50 percent effort</b><br>high school pitchers | 86 percent of velocity<br>75 percent of max elbow torque<br>80 percent of cumulative torque | Half effort in the athlete's head produced three quarters of the load. Observed effort falls far less than perceived effort does. |

## The practical consequence

A flat ground session at 70 percent is not a rest day. A bullpen where he takes something off is not recovery. **Manage workload by throw count and accumulated load, never by asking for a percentage**, because the percentage the athlete delivers is not the percentage he feels.

Reduced effort still has a place for skill work, command work and getting a feel for a new grip. It just does not belong in the column marked rest.

## The seven levers that do move it

From a study of 523 elite pitchers. Each is a position or a timing, each is measurable, and none of them are at the elbow.

| PUBLISHED ASSOCIATIONS WITH NORMALISED ELBOW VARUS TORQUE          |                                                  |                                                                                                                                                                                                                 |
|--------------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CHANGE THIS                                                        | DIRECTION                                        | WHY IT WORKS                                                                                                                                                                                                    |
| <b>Arm elevation at release</b><br>toward level with the shoulders | <b>increase</b>                                  | More elevation at release is associated with less load. Position of the lever relative to the line of force.                                                                                                    |
| <b>True maximum layback</b>                                        | <b>increase</b>                                  | The counterintuitive one. More real rotation reverses the arm over a longer arc, so peak force drops for the same change in momentum.<br><b>Layback is protective.</b>                                          |
| <b>Chest stacked and closed at foot contact</b>                    | <b>increase</b>                                  | Staying tilted back and closed at landing is inversely associated with load. Flying open is expensive.                                                                                                          |
| <b>Arm already turned over at foot contact</b>                     | <b>increase</b>                                  | Arriving with rotation already underway spreads the layback event across a longer arc instead of a snap.                                                                                                        |
| <b>When the hips peak</b>                                          | <b>earlier</b><br><small>weaker evidence</small> | Trends the right way but did not separate the high and low torque groups significantly. Included because the mechanical story is clean, flagged because the statistics are thinner than the rest of this table. |
| <b>Sideways lean at release</b>                                    | <b>decrease</b>                                  | Leaning away from the arm is how a shorter pitcher manufactures release height, and it is positively associated with load. Past about 48 degrees is a flag.                                                     |
| <b>Forward tilt at release</b>                                     | <b>increase</b>                                  | Listed here with a caveat: it lowers load in this model while also being the strongest positional correlate with velocity, which raises load. Treat as a trade rather than a free win.                          |

## There is no single fix, and that is the finding

Wake Forest's analysis of 298 pitchers reached the same conclusion from the other direction: their best prediction model explained only about **10 percent** of the variance. Their stated conclusion was that *small improvements across the whole delivery* beat any single mechanical change.

So the honest expectation is several levers, each worth a little, applied together. Anyone offering one adjustment that fixes elbow load is describing something the data does not support.

## The number that actually matters

Raw torque on a hard thrower is expected. Efficiency is the diagnostic.

### THE BAD TRADE

#### 28 percent more load for 1 percent more velocity

In the 523 pitcher sample, the high torque group carried roughly a quarter more normalised load and got almost nothing for it. That is the shape of a mechanical problem: the price went up and the product did not.

This is what you are looking for. Not a big number, but a big number attached to an ordinary outcome.

### THE WORST PROFILE

#### High load, low output

Preprofessional pitchers from the Dominican Republic showed **7.5 percent** size adjusted elbow load with *slower* hands than United States pitchers at **5.9 percent**. More stress, less velocity.

The authors attributed the gap to access to strength training and coaching rather than to anything innate. Inefficiency is a training history, not a trait.

## What size adjusted means, and why it matters here

Raw torque scales with how big and how strong the athlete is, so comparing a 5 foot 10 pitcher to a 6 foot 5 one on raw numbers tells you almost nothing.

**Normalised** figures divide the load by body weight and height, expressed as a percentage. Around **6 percent or higher** is the band researchers treat as high risk.

Then divide velocity by that and you have stress per mph, which is the only version of this number that answers the question you actually care about: *is he getting his money's worth.*

## Why the elbow is where the bill lands

### The ligament is already near its limit

Around peak layback the elbow sees a large twisting force. Reported magnitudes vary a lot by study, population and method, from around 30 Nm in some clinical summaries to Driveline's own sample average of **101 Nm**, so treat any single figure with caution. What is consistent is the comparison: cadaveric testing puts ligament failure at roughly **32 Nm**, which is *below* what is measured during pitching.

Which is the whole point. The ligament cannot be the sole restraint, because the load exceeds what it can take on its own. The muscles on the inside of the forearm are covering the difference on every single pitch. That is why fatigue is not an abstraction here, and why a mechanics conversation and a workload conversation are the same conversation.

It also explains the limits of arm care. Forearm strength is **armour**: it raises how long the athlete can hold up. It does not lower the load the delivery produces. Only the seven levers do that.

## What raises it

The other side of the same list, useful because these are the things that creep in rather than the things you would set out to do.



|                                                                                                                                                                                                                               |                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>POSITION</b></p> <p><b>Elbow more bent at foot contact</b></p> <p>More flexion at landing is associated with more load. The layback event compresses into a shorter, sharper arc. Reference is about a right angle.</p> | <p><b>POSITION</b></p> <p><b>Arm elevation off level at foot contact</b></p> <p>Drifting away from level cuts achievable layback, raises load and reduces joint stability. The elbow climb pattern is the common version.</p> | <p><b>SPEED</b></p> <p><b>Fast elbow extension</b></p> <p>Maximum elbow extension velocity is positively associated with load. Usually the signature of a pushing arm generating what it should have inherited.</p>                                       |
| <p><b>POSITION</b></p> <p><b>Sideways lean at release</b></p> <p>The mechanism behind a high release point on a shorter pitcher. It buys the release height and charges for it.</p>                                           | <p><b>TIMING</b></p> <p><b>Late hips</b></p> <p>The later peak hip rotation happens, the higher the load. No handoff means the arm supplies its own acceleration.</p>                                                         | <p><b>FATIGUE</b></p> <p><b>Innings four onward</b></p> <p>Across a simulated game, velocity fell about 0.28 mph per inning while medial elbow torque <b>rose</b> after the third, climbing roughly 0.84 Nm per inning. Throwing softer, paying more.</p> |

## Working on it

### STEP 1

#### Establish efficiency, not load

Get size adjusted torque and velocity together. A high number on a pitcher throwing 96 is a different situation from the same number on a pitcher throwing 86, and only one of them is a problem.

- Size adjusted load, with 6 percent as the band researchers flag
- Velocity alongside it, so you can compute stress per mph
- Then decide whether there is anything to fix at all

## STEP 2

## Audit the seven levers

Take them one at a time against his report. Expect two or three to be off rather than all seven, and expect each correction to be worth a little.

- Arm elevation at foot contact and at release
- Real layback, checked against fake layback
- Chest orientation at landing
- When the hips peak, weighted lower than the rest
- Sideways lean at release

## STEP 3

## Work upstream of the arm

Four of the seven levers are trunk or hip positions. Most of the leverage on elbow load is in the lower half, which is where the rest of this library lives.

- Hip timing and the block, which set whether a handoff happens at all
- Chest position at landing, which is the flying open problem
- Front side tissue, which gates real layback

## STEP 4

## Armour the forearm, and be clear about what it does

Worth doing, worth being honest about. It raises tolerance, it does not lower load.

- Wrist curls, palm down rotations, hammer rotations
- Heavy grip work: towel hangs, plate pinches, thick grip carries
- Track grip strength fresh against late in an outing, since that gap is the fatigue exposure
- Then manage throw count, because armour does not change the bill

## Sources

Reference values are population means with real spread. They locate an athlete, they do not grade one.

- Fleisig et al. — [Kinematic Parameters Associated With Elbow Varus Torque in Elite Adult Baseball Pitchers](#), 523 pitchers
- Wake Forest — [Association between pitching velocity and elbow varus torque](#), 298 pitchers
- Wolf, Kinney, Waterman, Bullock, Nicholson — [Differences in Pitching Kinetics and Kinematics During Various Effort Level Pitching](#)
- [Kinematic and kinetic comparison: Dominican Republic and United States preprofessional pitchers](#)

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- [Predicting elbow valgus torque from upper extremity kinematics using markerless motion capture](#)
  - [ASMI — The Clinician's Guide to Baseball Pitching Biomechanics](#)
  - [Driveline — How We Interpret Biomechanics Reports](#)
  - [Manifestations of muscle fatigue in baseball pitchers: a systematic review](#)
  - [Bullock, Nicholson et al. — Baseball pitching biomechanics in relation to pain, injury, and surgery](#)
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A big number on a hard thrower is expected. A big number on an ordinary outcome is the one to chase.