Botulinum Toxin Injection Improves Pain, Muscle Balance, and Patellar Tracking in Chronic Patellofemoral Pain

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Abstract

Objectives:
It has been suggested that injection of botulinum toxin to the vastus lateralis may be a reasonable treatment option for chronic patellofemoral pain (PFP), however, a mechanism for its effects has not been clearly elucidated. The present study aimed to evaluate the effects of botulinum toxin injection on pain, patellar tracking, and quadriceps muscle volume in patients with chronic PFP.

Design:
13 subjects (9 female and 4 male) with recalcitrant patellofemoral pain underwent an ultrasound-guided Botulinum Toxin Type A (BTX-A) injection to the vastus lateralis muscle. Following injection, participants were prescribed a 6-week course of physical therapy to emphasize quadriceps strengthening. A C-arm-based cone-beam CT scanner was used to uniquely assess three-dimensional patellofemoral joint kinematics during weightbearing pre- and post-intervention. Subjects were classified as normal trackers or maltrackers based on pre-intervention patellar position. CT scans were also used to quantify thigh muscle volume pre- and post-intervention. Primary outcome measures included (1) VAS pain scores, (2) Anterior Knee Pain Scale (AKPS) scores, (3) patellar tracking, and (4) vasti muscle cross sectional area (CSA).

Results:
Participants reported significantly improved AKPS scores post-intervention. Vastus lateralis muscle CSA deceased by 15.3% while vastus medialis muscle CSA increased by 15.8% at 6-week follow-up. The ratio of VL:VM CSA decreased from 1.03 (±0.05) pre-intervention to 0.79 (±0.04) post-intervention. In addition, among participants with baseline patellar maltracking, there were significant reductions in patellar tilt and bisect offset post-intervention.

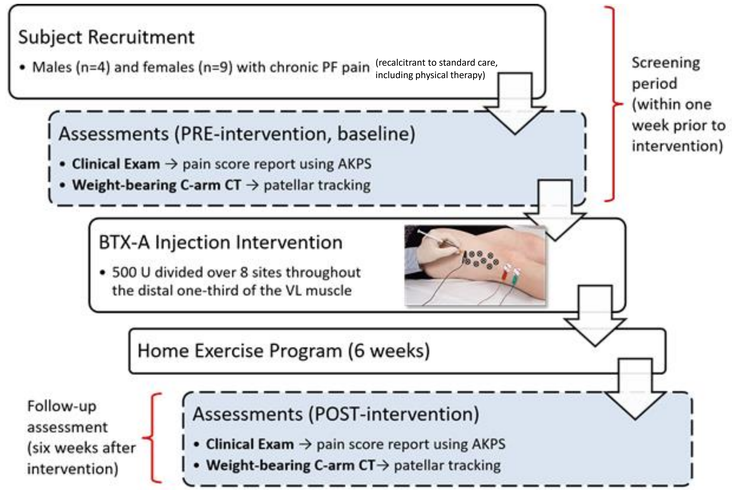
Conclusions:
Botulinum toxin injection to the vastus lateralis can improve pain and function in patients with chronic patellofemoral pain, possibly by balancing vasti muscle volume and activation. Moreover, botulinum toxin injection appears to improve patellar tracking in patients with premorbid maltracking.

Background

- Injection of botulinum toxin to the vastus lateralis has been proposed as a treatment option for PFP.
- This study was designed to further qualify the role of botulinum toxin in the management of PFP.
- It was hypothesized that botulinum toxin injection to the vastus lateralis would be associated with reduced pain, decreased vastus lateralis volume, and in turn, improved vastus muscle balance and patellar tracking in patients with chronic PFP.

Methods

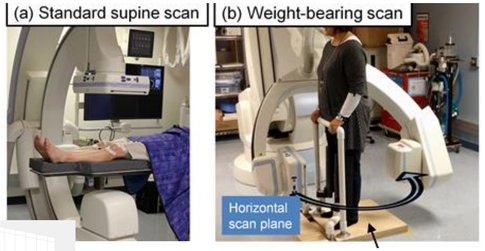
Figure 1: Study Design



Imaging Protocol

- A C-arm-based cone-beam CT scanner was used to uniquely assess three-dimensional patellofemoral joint kinematics under both non-weightbearing and weightbearing conditions.
- A joint coordinate system was used to describe patellar position with respect to the femur (Fig 3).
- Subjects were classified into normal tracking and maltracking groups.
- Patellar position was re-evaluated 6 – weeks post-intervention
- CT scans were also used to quantify vastus muscle cross sectional area (CSA).

Figure 2: CT Scanning Protocol



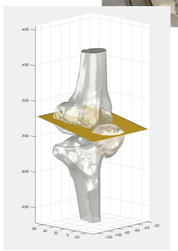
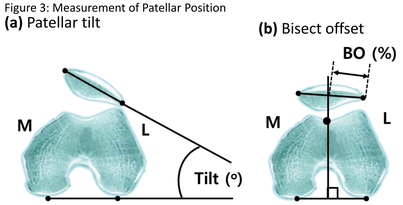


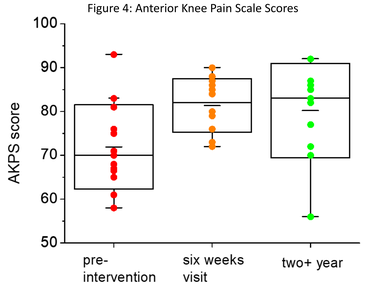
Figure 3: Measurement of Patellar Position



Results

- Participants reported significantly improved Anterior Knee Pain Scale (AKPS) scores at 6-weeks post-intervention (Fig 4).
- Improvements in AKPS scores were relatively preserved at long-term follow-up, ≥2 years post-intervention (Fig 4).
- Vastus lateralis muscle CSA deceased by 15.3% while vastus medialis muscle CSA increased by 15.8% at 6-week follow-up. The ratio of VL:VM CSA decreased from 1.03 (±0.05) pre-intervention to 0.79 (±0.04) post-intervention (Fig 5).

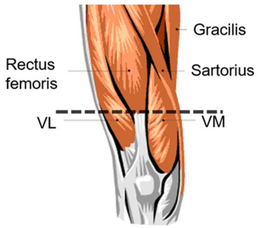
Figure 4: Anterior Knee Pain Scale Scores



- Regarding patellar tracking, no significant differences in patellar position were detected in the standard supine position.
- However, weightbearing images demonstrated significantly improved patellar position post-intervention, with reductions in patellar tilt and bisect offset among participants who demonstrated premorbid maltracking (Fig 6).

Results Cont'd

Figure 5: Vastus Muscle Cross Sectional Area



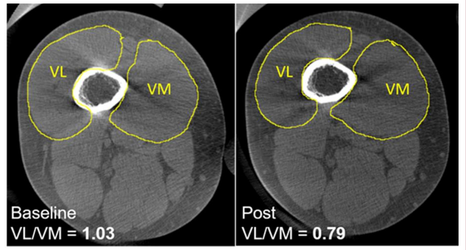
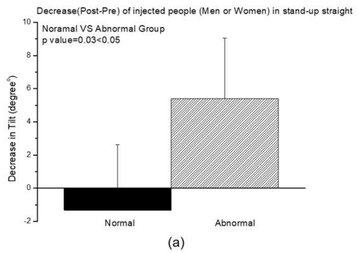
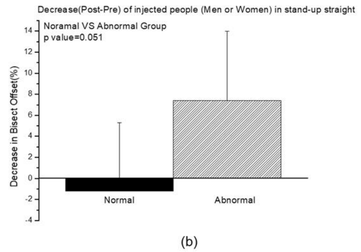


Figure 5: Vastus Muscle Cross Sectional Area





Conclusion

- In this study, botulinum toxin injection to the vastus lateralis was effective in the management of chronic patellofemoral pain, that had been previously recalcitrant to physical therapy.
- Botulinum toxin injection was associated with improved pain and function, reduced VL: VM cross sectional area, as well as improved patellar position (especially in premorbid maltrackers).
- Our findings support the notion that vastus muscle activation may be an important determinant of patellar tracking; and that interventions targeting vastus muscle activation may be most effective in treating patellofemoral pain subjects with premorbid patellar maltracking.
- Our study also illustrates the importance of assessing patellar kinematics during weightbearing conditions.

References

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