Comparison of Forteo® and Teriparatide on Improvements in Bone Mineral Density

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Background

- Forteo® (teriparatide) is a recombinant protein product classifying it as a biologic; market exclusivity expired in October 2019 allowing biosimilars to be introduced
- Approval of teriparatide biosimilar products was obtained through 505(B)(2) application rather than abbreviated BLA
  - 505(B)(2) – approval for generic medications; allows safety and efficacy information to come from studies not conducted by the applicant if it is demonstrated that the proposed product shares characteristics (active ingredient, dose, route of administration, strength, etc.) with the reference product and comparable pharmacokinetic data is established
  - Abbreviated BLA – approval for biosimilar products; manufacturers required to demonstrate that the product is highly similar to and has no clinically meaningful difference from the reference product through clinical studies
- Application for teriparatide biosimilar, PF708, included a randomized study comparing mean change from baseline in lumbar spine BMD to Forteo® at 24 weeks; results were not published due to inadequacies in the trial design
- There is currently no real-world outcomes data investigating safety and efficacy between PF708 teriparatide biosimilar and Forteo®

Objectives

Primary Objective:
compare percent change from baseline in BMD between patients treated with Forteo® or teriparatide

Secondary Objective:
compare safety and efficacy outcomes between Forteo® and teriparatide

Methods

- IRB approved, single-center, retrospective chart review of patients ≥ 18 years of age who received Forteo® or teriparatide prescriptions from the study location between October 1, 2019 and October 31, 2022
- Patients without DXA results at the conclusion of therapy were excluded

Primary Endpoints	Secondary Endpoints
BMD (g/cm^3) – *prior to and upon therapy completion* • Lumbar spine • Femoral neck (left/right) • Total hip (left/right)	• Safety: adverse effects, serum calcium (mg/dL, *prior to and during therapy)* • Efficacy: incidence of vertebral, non-vertebral, or hip fractures • Discontinuation of therapy and reason

BLA: biologic license application; BMD: bone mineral density; BMI: body mass index

Results

Table 1: Baseline Characteristics

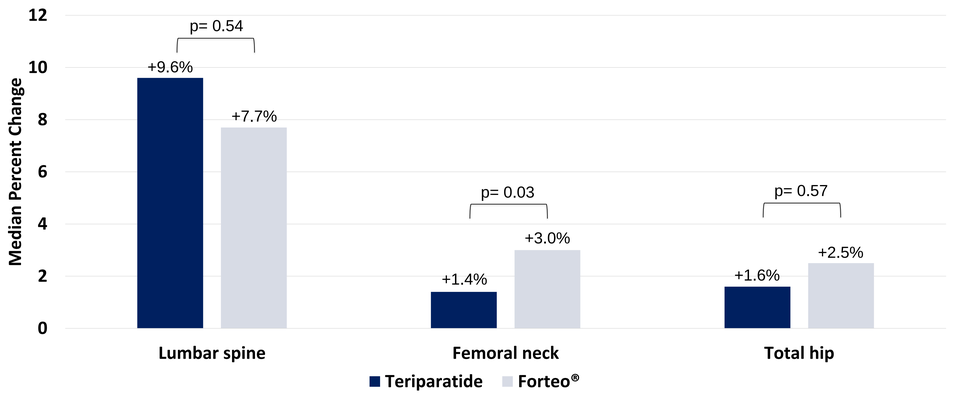
Characteristic	Teriparatide (N= 27)	Forteo® (N= 81)
Age, median (IQR)	67 (62.0 – 68.5)	68 (62.0 – 72.0)
Female, n (%)	24 (88.9)	71 (85.2)
Race, n (%)		
White/Caucasian	25 (92.6)	68 (84.0)
Asian	1 (3.7)	7 (8.6)
Black/African-American	---	3 (3.7)
BMI, median (IQR)	24 (20.2 – 26.6)	22.7 (20.1 – 25.4)
History of fracture, n (%)	22 (81.5)	64 (79.0)
Parent fractured hip, n (%)	7 (25.9)	21 (25.9)
Current smoker, n (%)	1 (3.7)	3 (3.7)
Glucocorticoid use, n (%)	3 (11.1)	9 (11.1)
History of rheumatoid arthritis, n (%)	1 (3.7)	1 (1.2)
Secondary osteoporosis[a], n (%)	5 (18.5)	15 (18.5)
Current alcohol use, n (%)	3 (11.1)	11 (13.6)
T-score, median (IQR)		
Lumbar spine	-3.1 (-3.5 – -2.5)	-2.5 (-3.5 – -1.7)
Femoral neck	-2.5 (-3.0 – -1.7)	-2.5 (-3.0 – -1.7)
Total hip	-2.0 (-2.5 – -1.7)	-2.0 (-2.8 – -1.5)

[a]Type I diabetes, osteogenesis imperfecta, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (< 45 years), chronic malnutrition or malabsorption, chronic renal failure (dialysis independent), chronic liver disease

Table 2: Bone Mineral Density (g/cm^2)

Median (IQR)	Lumbar Spine		Femoral Neck		Total Hip	
	Pre-Therapy	Post-Therapy	Pre-Therapy	Post-Therapy	Pre-Therapy	Post-Therapy
Teriparatide	0.825 (0.753 – 0.883)	0.887 (0.816 – 1.026)	0.678 (0.613 – 0.805)	0.721 (0.634 – 0.801)	0.737 (0.682 – 0.787)	0.766 (0.715 – 0.803)
Forteo®	0.867 (0.743 – 0.976)	0.939 (0.800 – 1.042)	0.679 (0.604 – 0.770)	0.704 (0.640 – 0.801)	0.736 (0.653 – 0.820)	0.764 (0.659 – 0.829)

Figure 1: Percent Change in Bone Mineral Density



Results

Table 3: Secondary Endpoints

	Teriparatide (N= 27)	Forteo® (N= 81)
Adverse Effect, n (%)	2 (7.4)	8 (9.9)
Reported adverse effects	• Rash • Fatigue • Constipation	• Nausea • Vomiting • Constipation • Pain • Rapid heartrate • Hypercalcemia
Outcome of adverse effect, n (%)		
Continuation of therapy	---	5 (6.2)
Discontinuation of therapy	1 (3.7)	3 (3.7)
Hold therapy	1 (3.7)	---
Change in serum calcium (mg/dL), median IQR	0.3 (0.03 – 0.58)	0.2 (-0.1 – 0.4)
Fracture during therapy, n (%)	5 (18.5)	12 (14.8)
Discontinuation of therapy[a], n (%)	1 (3.7)	8 (9.9)
Reason for discontinuation	• Patient preference • Minimal improvement in BMD • Insurance barriers • Adherence	

[a]Reason other than adverse effect

Discussion/Conclusion

- Patients included are representative of the patient population indicated for anabolic therapy for osteoporosis
- Percent change in BMD in lumbar spine and total hip from baseline was not significant; percent change in BMD in femoral neck was significant between Forteo® and PF708 teriparatide biosimilar
- Approximately 7.4% (teriparatide) and 9.9% (Forteo®) of patients reported adverse effects; most common were rash, fatigue, and constipation
- Primary endpoint results are comparable to those of other studies published in the United States, Asia, Europe investigating differences between Forteo® and alternative biosimilars
- Results of this study provide real-world safety and efficacy data comparing teriparatide biosimilar, PF708, to Forteo®
- Limitations: retrospective review, small sample size

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For More Information

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