



Full wwPDB NMR Structure Validation Report ⓘ

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PDB ID : 2N8R
BMRB ID : 25859
Title : Productive complex between MMP-12 and synthetic triple-helical collagen, revealed through paramagnetic NMR
Authors : Prior, S.H.; Van Doren, S.R.
Deposited on : 2015-10-24

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A user guide is available at

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with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 2022.3.0, CSD as543be (2022)
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
wwPDB-RCI : v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV : Wang et al. (2010)
wwPDB-ShiftChecker : v1.2
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.41.4

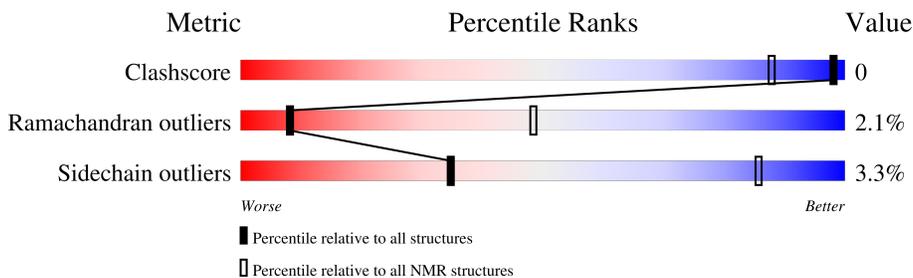
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 58%.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	NMR archive (#Entries)
Clashscore	210492	14027
Ramachandran outliers	207382	12486
Sidechain outliers	206894	12463

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and a grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	164	
2	B	36	
2	C	36	
2	D	36	

2 Ensemble composition and analysis

This entry contains 1 models. Identification of well-defined residues and clustering analysis are not possible.

3 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 3850 atoms, of which 1854 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Macrophage metalloelastase.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	164	2513	826	1222	225	236	4	0

- Molecule 2 is a protein called Collagen triple helix repeat family protein.

Mol	Chain	Residues	Atoms					Trace
			Total	C	H	N	O	
2	B	36	443	144	210	38	51	0
2	C	36	443	144	210	38	51	0
2	D	36	443	144	210	38	51	0

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	
			Total	Zn
3	A	2	2	2

- Molecule 4 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	
			Total	Ca
4	A	3	3	3

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		
			Total	H	O
5	A	1	3	2	1

4 Residue-property plots [i](#)

These plots are provided for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic is the same as shown in the summary in section 1 of this report. The second graphic shows the sequence where residues are colour-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outliers are shown as green connectors. Residues which are classified as ill-defined in the NMR ensemble, are shown in cyan with an underline colour-coded according to the previous scheme. Residues which were present in the experimental sample, but not modelled in the final structure are shown in grey.

- Molecule 1: Macrophage metalloelastase

Chain A:  90% 9%



- Molecule 2: Collagen triple helix repeat family protein

Chain B:  94% 6%



- Molecule 2: Collagen triple helix repeat family protein

Chain C:  97%



- Molecule 2: Collagen triple helix repeat family protein

Chain D:  78% 19%



5 Refinement protocol and experimental data overview

The models were refined using the following method: *Rigid-body docking, Conformer selection*.

Of the 7500 calculated structures, 1 were deposited, based on the following criterion: *back calculated data agree with experimental NOESY spectrum*.

The following table shows the software used for structure solution, optimisation and refinement.

Software name	Classification	Version
HADDOCK	structure solution	2.1
q test.py	structure solution	
GROMOS	refinement	
HADDOCK	refinement	2.1
q test.py	refinement	

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 7 of this report.

Chemical shift file(s)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	1753
Number of shifts mapped to atoms	1753
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	58%

6 Model quality i

6.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, HYP, CA

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the (average) root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	#Z>5	RMSZ	#Z>5
1	A	0.75	0/1331 (0.0%)	1.11	10/1802 (0.6%)
2	B	0.72	0/170 (0.0%)	0.89	0/224 (0.0%)
2	C	0.67	0/170 (0.0%)	0.87	0/224 (0.0%)
2	D	0.72	0/170 (0.0%)	1.12	0/224 (0.0%)
All	All	0.73	0/1841 (0.0%)	1.07	10/2474 (0.4%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	Chirality	Planarity
1	A	0	2
All	All	0	2

There are no bond-length outliers.

All angle outliers are listed below. They are sorted according to the Z-score.

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	170	ASP	CB-CG-OD1	10.74	127.97	118.30
1	A	124	ASP	CB-CG-OD1	9.38	126.74	118.30
1	A	101	ARG	NE-CZ-NH1	7.74	124.17	120.30
1	A	170	ASP	OD1-CG-OD2	-6.92	110.15	123.30
1	A	256	ARG	NE-CZ-NH1	6.78	123.69	120.30
1	A	127	ARG	NE-CZ-NH1	6.55	123.57	120.30
1	A	165	ARG	NE-CZ-NH1	6.24	123.42	120.30
1	A	124	ASP	OD1-CG-OD2	-5.74	112.40	123.30
1	A	249	ARG	NE-CZ-NH1	5.46	123.03	120.30
1	A	117	ARG	NE-CZ-NH1	5.44	123.02	120.30

There are no chirality outliers.

All planar outliers are listed below.

Mol	Chain	Res	Type	Group
1	A	174	PHE	Peptide
1	A	240	TYR	Sidechain

6.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in each chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes averaged over the ensemble.

Mol	Chain	Non-H	H(model)	H(added)	Clashes
1	A	1291	1222	1219	1
All	All	1996	1854	1843	1

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 0.

All clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)
1:A:237:PHE:CD1	1:A:238:PRO:HD2	0.46	2.46

6.3 Torsion angles [i](#)

6.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all NMR entries. The Analysed column shows the number of residues for which the backbone conformation was analysed and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	162/164 (99%)	156 (96%)	4 (2%)	2 (1%)	14	62
2	B	27/36 (75%)	26 (96%)	1 (4%)	0 (0%)	100	100
2	C	27/36 (75%)	27 (100%)	0 (0%)	0 (0%)	100	100
2	D	27/36 (75%)	22 (81%)	2 (7%)	3 (11%)	1	8
All	All	243/272 (89%)	231 (95%)	7 (3%)	5 (2%)	8	48

All 5 Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type
1	A	171	PHE
1	A	238	PRO
2	D	88	GLY
2	D	89	VAL
2	D	92	GLU

6.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all NMR entries. The Analysed column shows the number of residues for which the sidechain conformation was analysed and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	132/132 (100%)	128 (97%)	4 (3%)	37	87
2	B	16/16 (100%)	16 (100%)	0 (0%)	100	100
2	C	16/16 (100%)	16 (100%)	0 (0%)	100	100
2	D	16/16 (100%)	14 (88%)	2 (12%)	6	48
All	All	180/180 (100%)	174 (97%)	6 (3%)	35	86

All 6 residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type
1	A	101	ARG
1	A	102	GLU
1	A	131	ASP
1	A	150	SER
2	D	92	GLU
2	D	95	GLU

6.3.3 RNA [i](#)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains [i](#)

24 non-standard protein/DNA/RNA residues are modelled in this entry.

In the following table, the Counts columns list the number of bonds for which Mogul statistics could be retrieved, the number of bonds that are observed in the model and the number of bonds that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length is the number of standard deviations the observed value is removed from the expected value. A bond length with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond lengths.

Mol	Type	Chain	Res	Link	Bond lengths		
					Counts	RMSZ	#Z>2
2	HYP	D	78	2	7,8,9	0.43	0 (0%)
2	HYP	C	45	2	7,8,9	0.68	0 (0%)
2	HYP	D	108	2	9,9,9	0.73	0 (0%)
2	HYP	B	6	2	7,8,9	0.63	0 (0%)
2	HYP	B	12	2	7,8,9	0.70	0 (0%)
2	HYP	D	102	2	7,8,9	0.68	0 (0%)
2	HYP	B	30	2	7,8,9	0.68	0 (0%)
2	HYP	C	42	2	7,8,9	0.72	0 (0%)
2	HYP	D	84	2	7,8,9	0.58	0 (0%)
2	HYP	D	99	2	7,8,9	0.67	0 (0%)
2	HYP	C	69	2	7,8,9	0.60	0 (0%)
2	HYP	B	3	2	7,8,9	0.70	0 (0%)
2	HYP	C	72	2	9,9,9	0.78	0 (0%)
2	HYP	D	81	2	7,8,9	0.75	0 (0%)
2	HYP	B	33	2	7,8,9	0.69	0 (0%)
2	HYP	D	105	2	7,8,9	0.65	0 (0%)
2	HYP	B	27	2	7,8,9	0.65	0 (0%)
2	HYP	C	39	2	7,8,9	0.59	0 (0%)
2	HYP	C	63	2	7,8,9	0.74	0 (0%)
2	HYP	D	75	2	7,8,9	0.44	0 (0%)
2	HYP	B	36	2	9,9,9	0.78	0 (0%)
2	HYP	C	66	2	7,8,9	0.62	0 (0%)
2	HYP	B	9	2	7,8,9	0.46	0 (0%)
2	HYP	C	48	2	7,8,9	0.79	0 (0%)

In the following table, the Counts columns list the number of angles for which Mogul statistics could be retrieved, the number of angles that are observed in the model and the number of angles that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond angle is the number of standard deviations the observed value is removed from the expected value. A bond angle with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond angles.

Mol	Type	Chain	Res	Link	Bond angles		
					Counts	RMSZ	#Z>2
2	HYP	D	78	2	5,10,12	1.09	1 (20%)

Mol	Type	Chain	Res	Link	Bond angles		
					Counts	RMSZ	#Z>2
2	HYP	C	45	2	5,10,12	1.29	0 (0%)
2	HYP	D	108	2	10,12,12	1.23	1 (10%)
2	HYP	B	6	2	5,10,12	0.86	0 (0%)
2	HYP	B	12	2	5,10,12	0.99	0 (0%)
2	HYP	D	102	2	5,10,12	0.77	0 (0%)
2	HYP	B	30	2	5,10,12	0.78	0 (0%)
2	HYP	C	42	2	5,10,12	0.77	0 (0%)
2	HYP	D	84	2	5,10,12	1.77	3 (60%)
2	HYP	D	99	2	5,10,12	1.02	0 (0%)
2	HYP	C	69	2	5,10,12	0.76	0 (0%)
2	HYP	B	3	2	5,10,12	0.71	0 (0%)
2	HYP	C	72	2	10,12,12	1.42	2 (20%)
2	HYP	D	81	2	5,10,12	0.73	0 (0%)
2	HYP	B	33	2	5,10,12	0.74	0 (0%)
2	HYP	D	105	2	5,10,12	0.79	0 (0%)
2	HYP	B	27	2	5,10,12	1.39	1 (20%)
2	HYP	C	39	2	5,10,12	0.77	0 (0%)
2	HYP	C	63	2	5,10,12	0.82	0 (0%)
2	HYP	D	75	2	5,10,12	1.43	1 (20%)
2	HYP	B	36	2	10,12,12	0.92	0 (0%)
2	HYP	C	66	2	5,10,12	0.82	0 (0%)
2	HYP	B	9	2	5,10,12	1.49	1 (20%)
2	HYP	C	48	2	5,10,12	0.78	0 (0%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	HYP	D	78	2	-	0,0,11,13	0,1,1,1
2	HYP	C	45	2	-	0,0,11,13	0,1,1,1
2	HYP	D	108	2	-	0,4,13,13	0,1,1,1
2	HYP	B	6	2	-	0,0,11,13	0,1,1,1
2	HYP	B	12	2	-	0,0,11,13	0,1,1,1
2	HYP	D	102	2	-	0,0,11,13	0,1,1,1
2	HYP	B	30	2	-	0,0,11,13	0,1,1,1
2	HYP	C	42	2	-	0,0,11,13	0,1,1,1
2	HYP	D	84	2	-	0,0,11,13	0,1,1,1
2	HYP	D	99	2	-	0,0,11,13	0,1,1,1
2	HYP	C	69	2	-	0,0,11,13	0,1,1,1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	HYP	B	3	2	-	0,0,11,13	0,1,1,1
2	HYP	C	72	2	-	0,4,13,13	0,1,1,1
2	HYP	D	81	2	-	0,0,11,13	0,1,1,1
2	HYP	B	33	2	-	0,0,11,13	0,1,1,1
2	HYP	D	105	2	-	0,0,11,13	0,1,1,1
2	HYP	B	27	2	-	0,0,11,13	0,1,1,1
2	HYP	C	39	2	-	0,0,11,13	0,1,1,1
2	HYP	C	63	2	-	0,0,11,13	0,1,1,1
2	HYP	D	75	2	-	0,0,11,13	0,1,1,1
2	HYP	B	36	2	-	0,4,13,13	0,1,1,1
2	HYP	C	66	2	-	0,0,11,13	0,1,1,1
2	HYP	B	9	2	-	0,0,11,13	0,1,1,1
2	HYP	C	48	2	-	0,0,11,13	0,1,1,1

There are no bond-length outliers.

All angle outliers are listed below. They are sorted according to the Z-score.

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	84	HYP	CG-CB-CA	2.49	106.63	103.75
2	B	9	HYP	O-C-CA	2.44	118.50	124.77
2	C	72	HYP	CB-CG-CD	2.38	105.81	103.16
2	D	75	HYP	CB-CG-CD	2.33	100.56	103.16
2	D	78	HYP	O-C-CA	2.22	119.05	124.77
2	D	84	HYP	CB-CG-CD	2.22	105.63	103.16
2	C	72	HYP	CG-CB-CA	2.22	106.31	103.75
2	B	27	HYP	CB-CG-CD	2.17	105.58	103.16
2	D	108	HYP	C-CA-N	2.16	115.28	106.84
2	D	84	HYP	O-C-CA	2.04	119.53	124.77

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

6.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 5 are monoatomic - leaving 0 for Mogul analysis.

6.7 Other polymers [i](#)

There are no such molecules in this entry.

6.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

7 Chemical shift validation [i](#)

The completeness of assignment taking into account all chemical shift lists is 58% for the well-defined parts and 58% for the entire structure.

7.1 Chemical shift list 1

File name: working_cs.cif

Chemical shift list name: *chem_shift_list_1*

7.1.1 Bookkeeping [i](#)

The following table shows the results of parsing the chemical shift list and reports the number of nuclei with statistically unusual chemical shifts.

Total number of shifts	1753
Number of shifts mapped to atoms	1753
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	3

7.1.2 Chemical shift referencing [i](#)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction \pm precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	159	-0.24 ± 0.10	None needed (< 0.5 ppm)
$^{13}\text{C}_\beta$	137	0.11 ± 0.15	None needed (< 0.5 ppm)
$^{13}\text{C}'$	128	-0.18 ± 0.15	None needed (< 0.5 ppm)
^{15}N	153	-0.73 ± 0.25	Should be applied

7.1.3 Completeness of resonance assignments [i](#)

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 58%, i.e. 1753 atoms were assigned a chemical shift out of a possible 3008. 0 out of 24 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	770/1222 (63%)	330/515 (64%)	287/496 (58%)	153/211 (73%)
Sidechain	825/1504 (55%)	544/981 (55%)	272/477 (57%)	9/46 (20%)

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	Total	¹H	¹³C	¹⁵N
Aromatic	158/282 (56%)	79/142 (56%)	76/128 (59%)	3/12 (25%)
Overall	1753/3008 (58%)	953/1638 (58%)	635/1101 (58%)	165/269 (61%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 58%, i.e. 1753 atoms were assigned a chemical shift out of a possible 3008. 0 out of 24 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹H	¹³C	¹⁵N
Backbone	770/1222 (63%)	330/515 (64%)	287/496 (58%)	153/211 (73%)
Sidechain	825/1504 (55%)	544/981 (55%)	272/477 (57%)	9/46 (20%)
Aromatic	158/282 (56%)	79/142 (56%)	76/128 (59%)	3/12 (25%)
Overall	1753/3008 (58%)	953/1638 (58%)	635/1101 (58%)	165/269 (61%)

7.1.4 Statistically unusual chemical shifts [i](#)

The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

List Id	Chain	Res	Type	Atom	Shift, ppm	Expected range, ppm	Z-score
1	A	214	LEU	CG	33.00	21.37 – 32.19	5.8
1	A	226	LEU	CG	33.00	21.37 – 32.19	5.8
1	A	224	LEU	CG	32.30	21.37 – 32.19	5.1

7.1.5 Random Coil Index (RCI) plots [i](#)

The image below reports *random coil index* values for the protein chains in the structure. The height of each bar gives a probability of a given residue to be disordered, as predicted from the available chemical shifts and the amino acid sequence. A value above 0.2 is an indication of significant predicted disorder. The colour of the bar shows whether the residue is in the well-defined core (black) or in the ill-defined residue ranges (cyan), as described in section 2 on ensemble composition. If well-defined core and ill-defined regions are not identified then it is shown as gray bars.

Random coil index (RCI) for chain A:

